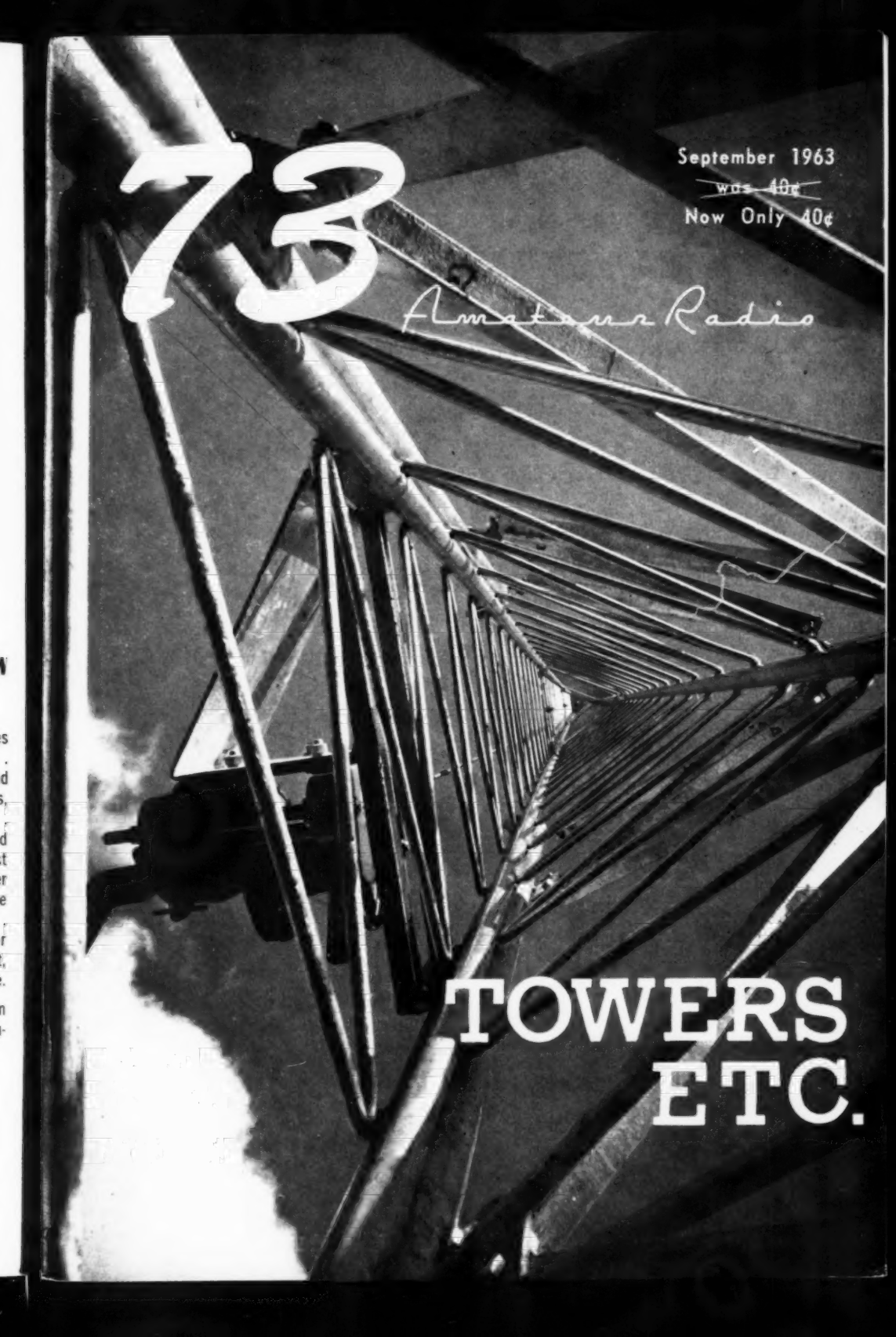
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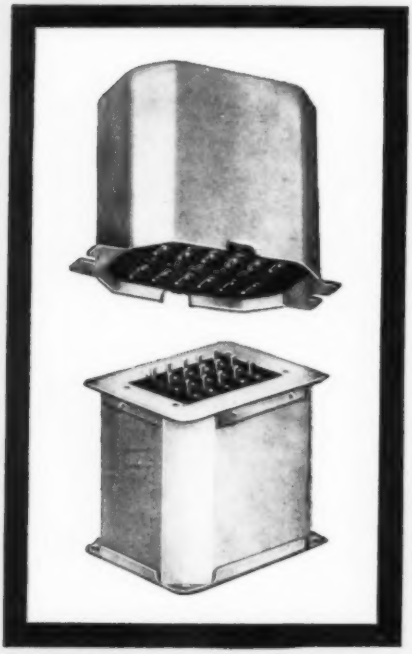

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73

Magazine

Wayne Green W2NSD/1

Editor, etcetera

September, 1963

Vol. XIV, No. 9

Cover:
Tri-Ex Tower

Cast Iron Balun W4WKM 8
Using ferrite core inductors. 73 parts kit vailable.

CW Noise Limiter W6SFM 10
Or have you noticed that your noise limiter turns off on CW?

Errorless RTTY Converter K5JKX 12
Well, almost errorless.

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As contrasted with the more popular Scotch S-Meters. Parts kit on this.

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de W2NSD

never say die

The way things are popping these days we need a weekly newsletter to keep up instead of a monthly magazine. The biggest bombshell was the publication of part of the "Doyle Diaries" by Evans K6BX in his Newsletter. I'm pretty sure that you won't read one word about this in QST or me-too CQ, which leaves only 73 to spill the beans.

Those of you who are morbidly addicted to my editorials know that I take an awfully dim view of the way K6BX goes about things. He is usually sickenly pompous and emotional in his rantings and often destructive. Well, he hasn't changed. His latest Newsletter emotes and pompouses on for 28 pages; it is a lulu. I enjoyed it.

The important part of the Newsletter, almost hidden amongst the onrush of hysteria, was a word quote of a letter purportedly written by ex-League Director John Doyle W9GPI. I had heard rumors of such letters and how they exposed a plot on the part of a few Directors to take over the ARRL and run it with an iron fist. I had heard that these letters were involved with the sudden resignation of Doyle a few months back. The letter published by K6BX describes in fairly good detail the whole plot . . . the way these men went about reworking the ARRL management system so they could control it . . . their incredible plans for the future . . . and he pulls no punches, naming names and giving intimate secrets about Huntoon . . . Hoover . . . control of QST . . . Budlong being fired . . . how they brow-beat wishy-washy Directors into letting all this happen . . . and on and on.

If the material is a hoax then we should see a healthy legal suit developing. If it is factual, and the details of the letter are hard not be believe since the plans laid out jibe so closely with the events that have happened, then the question arises, "what can be done about the situation and how can it be prevented from happening again?" Since this throws a dark cloud cover over the election of the present Directors one solution might be to turn their chairs over to the Vice-Directors. These gentlemen could then set about eliminating the new Executive Committee system of running things which virtually invites someone to step in and become dictator, with concomitant building funds, cancellations of national conventions, and proposed rules changes being frced down the members' throats.

I suspect that K6BX's News Letter #14 (30¢) may have to go into additional printings.

Incentive Licensing

My mailbag runneth over. A few in favor of restricted voice bands have written in . . . "get all those damned lids off the phone bands" . . . and a couple of thousand opposing it have registered their protest. I've been accused of bias . . . and I admit it. To get the opposite bias you'll just have to read QST.

I do join the proponents of incentive licensing in one thing: decrying the large number of amateurs who,t once they have obtained their license, are content to buy a station and settle back to just plain operating. Few of these chaps read 73 for we have little of interest for them, so there isn't much point in my talking about it here.

But must we turn to government edict to force these lazy amateurs to mend their ways? Must we inconvenience or discourage tens of thousands of amateurs who do take an interest in their hobby? Perhaps there is another way. I know this is heretical in these days of leaping socialism, but my tendency is to try to get along with a minimum of laws and a maximum of understanding and cooperation.

What other incentives are there besides frequency allocations? I'm sure we can come up with something else. Power differentials have been suggested. This, like frequency segregations, would be difficult to police, requiring the FCC monitoring stations to increase their staffs or else forget the whole thing. There are so many multi-kilowatt stations on the air today undetected that it just isn't feasible.

Special call signs have been suggested. I'm inclined to like this idea. Since the old order of call signs has been virtually wrecked we might be able to set up a call sign system which

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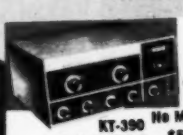

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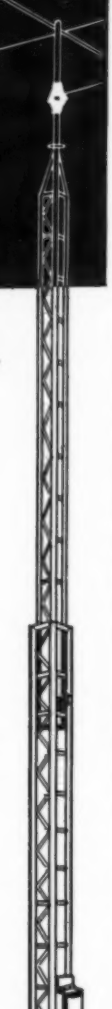

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would reflect license qualifications. Suppose we establish six grades of licenses: Novice, Technician, General, Advanced (same technical exam as Extra, but without 20 wpm code), Extra, and Special (particularly awful exam). The class of license could be designated by the second letter of the call and the status of this special letter would I'll bet, drive a lot of fellows toward higher classes of license. "Double-you Bee Two See Cue Em, this is Double-you (heh, heh) Ess Two En Ess Dee." Well, you know that CQM isn't going to stand that one for long. The extra letter in the call would be a mark of accomplishment and would be much sought after. The lazy amateur would be branded as such every time he goes on the air.

ARRL

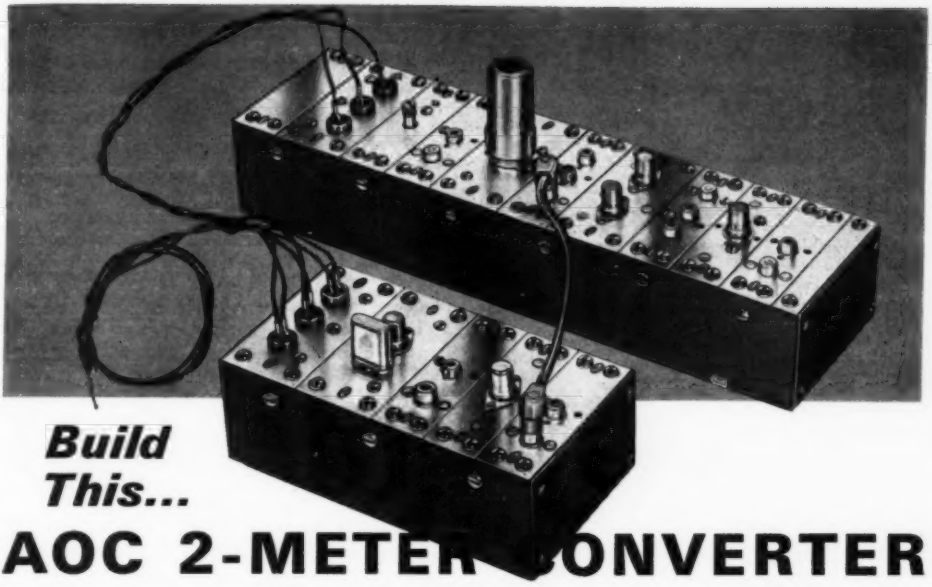
If my mail reflects the anti-segregation feelings of the amateurs so strongly, I can just imagine the tenor of the mail flooding in down at Newington. In spite of this mail, the August issue of QST is virtually silent on the subject. One letter in favor, none against, and not one word in the editorial. We don't find out what is really going on until we check into the mice-type in the "Happenings" where we find that the ARRL has submitted two petitions to the FCC, both requesting the assignment of portions of the bands for higher grades of licenses.

There are indications that the pressure of resigning members and irate manufacturers and distributors is being felt. We shall see in the September QST how much they have backed down. It is possible that they may ask that small segment of the phone bands (50 kc) be set aside for higher classes of licenses. This is a good compromise for it is doubtful if the FCC would set themselves up with such a monitoring headache, which would let the whole mess blow over.

The Institute

The shocking exposure of the ARRL by K6BX and the cynical admittance by the League in the July QST editorial that they had no intention of polling the members before making even the most drastic of decisions for them has brought in such a pile of mail demanding that something be done that I have taken a little time off from my mad race to keep everything running here and tried to work out a possible solution to the problem.

The first step in solving a problem is to identify the problem. Perhaps I am oversimplifying things, but it seems to me that



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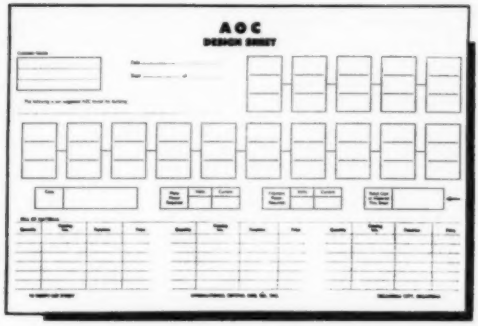

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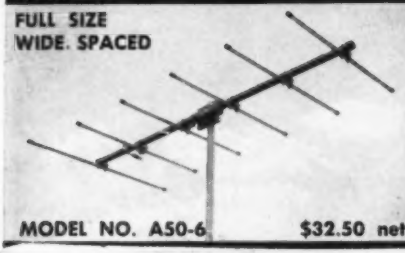

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our difficulty is one of communication . . . which is a strange one for a hobby such as ours. But see if I'm not right in this. I suspect that we need a good method of communications for all amateurs to know what is going on and to participate in the formation of new rules r modifications of old ones. If we could find some way to provide a bias-free method of letting amateurs know what each other are thinking I believe that our hobby would run a lot smoother.

Now . . . how do we accomplish such a thing? Well, I have a suggestion.

I propose that we set up an Area Coordinator for each call area who will report on the matters discussed and resolved by clubs within his area. Each Area Coordinator will have Division Directors for each section of his area and these men will attend local club meetings and report on the decisions reached by clubs within their sections. An Area Coordinator might have from five to fifteen Division Directors to keep him up to date on all of his area. The DD will be in touch with the clubs on a direct basis and in touch with club officers so that his reports will reflect the thinking of the amateurs in his section. The Area Coordinator will make a report including the information from the DD's and this report will be published each month by the Institute of Amateur Radio and copies will be distributed to AC's, DD's, all officials of the FCC, ARRL Directors and officers, all government offices in any way involved with amateur radio (MARS, etc.), and by suscription to any amateurs interested in knowing just what is what for the nominal subscription rate of $1 per year, which doesn't cover the costs involved by a long shot, but which will weed out those upon whom it might be wasted.

This whole thing will take a bit of doing, but I think we can get it set up before the end of the year.

This will provide a means for all amateurs who are interested enough in their hobby to attend club meetings or write to their Division Director with their opinions to know what is going on and to wield some influence in the course of amateur affairs. Our little bulletin should be invaluable to the FCC in their honest attempt to manage our hobby in our best interests and should be equally helpful to ARRL Directors, perhaps preventing them from going off on a tangent undesired by the amateurs because of the personal influence of one or two Directors. Since the ARRL is not providing any such service I hope they won't

(Turn to page 88)

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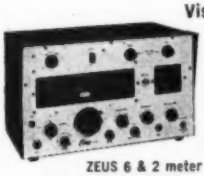

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A Cast-Iron Balun

73 Parts Kit

Roy Pafenberg W4WKM
316 Stratford Avenue
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Photo Credit: Morgan S. Gassman, Jr.

Ferrite components and ferrite core inductors have come into general use in recent years. Despite their appearance in a very wide range of common equipments, many amateurs remain unaware of the amateur equipment applications of these materials and commonly available components. Commercial applications range from the "rod" antennas used in transistor portables to the universally used ferrite core TV horizontal deflection components. One component, which has immediate amateur application, is the broad band matching transformer, or balun, which is widely used in modern TV tuners.

The balun is housed in a Minibox and commercial decals finish off the job. Various views of the unmounted balun are also shown.

Before we go into the applications of the ferrite core unit, a review of the baluns in current amateur use is in order. Baluns (BALanced to UNbalanced rf transformers) are widely used to effect transition from balanced to unbalanced transmission lines with an impedance transformation of 4 to 1. In amateur VHF practice, the most common form of balun is of the coaxial cable type.[1]

In this configuration, a half-wave phasing section of coaxial cable is connected in parallel with the coaxial transmission line. The balanced connection is made across the center conductor terminations of the phasing section which provides the required 180° phase reversal. Since the voltages at the unbalanced end of the circuit are in parallel and the voltages at the balanced end are in series, there is a 4 to 1 impedance step-up from the unbalanced line to the balanced output. While performance of these coaxial line baluns is excellent, there are obstacles. The major problems are the length of line required for the phasing section at the lower frequencies and the limited bandwidth over which a particular balun will operate.

The limited bandwidth problem is overcome in the untuned coil balun. In this configuration, two bifilar wound coils are connected as shown in Fig. 1. At the series connected end, the lines are balanced to ground and will match an impedance of twice the characteristic impedance of the line. At the parallel connected, or unbalanced, end the circuit will be matched by an impedance of half that of the coiled lines. This results in an impedance transformation of 4 to 1. For this circuit to work, the input must be effectively decoupled from the

1. "Coaxial Baluns," WA2INM; December 1962, 73 Magazine

output and this must be accomplished without introducing excesive losses.

In theory, this condition will occur only when the coiled transmission lines are an odd multiple of a quarter wave in length. However, in practice, the coiled lines serve as a choke which effectively decouples the input from the output. Since the inductance of the choke is not critical, these balums will function over a wide range of frequencies. Bandwidths of 10 to 1 are normal with the lower frequency limit being that at which the windings are less than a quarter wave in length.

The familiar "ladder" coils used in the antenna input circuit of early television receivers were a commercial application of this type balun. Many amateurs have used these coils in their VHF installations with good results. It should be noted that in this discussion only the most common series-parallel balun configuration is treated. This connection results in the 4 to 1 impedance transformation and a transition from balanced to unbalanced lines. Other connections are possible but are beyond the scope of this article. It is in this 75 to 300 ohm, unbalanced to balanced configuration that the TV baluns have been most often used.

With the availability of economical, modern ferrite core materials, their use in TV receiver baluns was a logical development. Since the efficiency of the ferrite core baluns for receiving applications in the range of 54 to 216 mc has been proven in several million TV receivers, it was considered worthwhile to try these units at the lower frequencies. In addition, it was desired to test them in low power transmitting applications. John Landek W9WOK, of Admiral was approached for details on these units and he kindly came through with the information and some samples of the coils used in Admiral TV receivers.

These baluns were used unchanged in the tests that were conducted. The windings of the baluns were connected as is shown in Fig. 1 and the balanced termination connected to a 200 ohm resistive load. The unbalanced termination was connected through a commercial SWR meter to the output of a 3.5 to 60 mc low power transmitter. RG-58/U cable was used between the transmitter, the SWR meter and the balun. The 4 to 1 ratio of SWR meter and the balun. The 4 to 1 ratio of the balun is maintained in this test and use of the 50 ohm line enabled use of the 50 ohm SWR meter and a commercial 50 ohm rf power meter for comparative tests. Subsequent on the air tests verified that similar results are obtained in 75 ohm unbalanced to 300 ohm balanced applications.

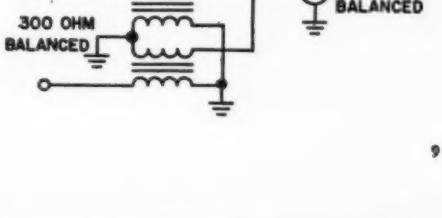
The transmitter was modulated about 90% with a 1000 cycle test tone and the balanced deflection plates of a monitor scope were connected across the 200 ohm load. The purpose of the scope was to observe the modulated rf envelope for flat-topping or other evidence of balun core saturation on modulation peaks. Rf voltage across each half of the 200 ohm load resistor was measured with a Hewlett-Packard 410B VTVM and the actual power in the load computed from these readings. These readings were verified by substituting a commercial rf power meter for the balun and 200 ohm load. The commercial SWR meter was left in the line and switched to the relative power position to insure that the transmitter output remained essentially unchanged under both test conditions. The fingers and the nose were used to gauge heating of the balun core and windings.

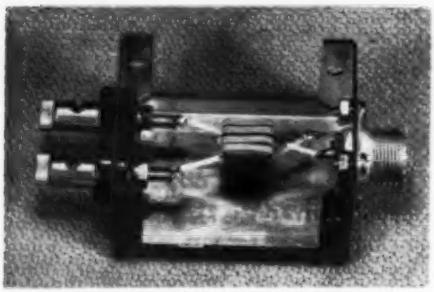
The transmitter was tuned up on 6 meters into the 50 ohm power meter and the loading adjusted for 15 watts output. After the SWR was verified as being essentially 1 to 1, the output was transferred to the balun terminated in the 200 ohm load. Transmitter tuning was touched up for exactly 15 watts output and the SWR was read and recorded. This procedure was repeated on 10, 20 and 40 meters. The balun did not heat excessively at any frequency and no distortion of the modulated rf envelope was noted. Results of these tests were as follows:

Frequency in mc	54	28	14	7
SWR	1.1:1	1.2:1	1.4:1	1.6:1

The transmitter was retuned to 54 mc and the power increased until excessive heating of the balun was observed. The SWR rose slightly at this power level but the rf envelope remained undistorted on modulation peaks. This test was repeated with other baluns of the same type and in each case, excessive heating was noted at between 20 and 25 watts.

Based on these tests, it appears that the unmodified TV baluns will be perfectly satisfactory for use on 6 and 10 meters, could be used on 20 meters and *might* be used on 40 meters. Just to play it safe, a maximum power of 20 watts should not be exceeded. Although the TV baluns were not tested on 2 meters, there is no reason why they should not be fully satisfactory





The ferrite core balun is connected to the coaxial receptacle and the binding post terminals. The balun is supported by its leads.

at these frequencies. As mentioned, the baluns were used unchanged. Somewhat better low frequency performance might be obtained by increasing the number of turns in the windings. However, it is believed that General Ceramics Q-2 ferrite material is used in the cores. General Ceramics recommends this material for use in wide band transformers between 10 and 225 mc so it is doubtful that performance at the lower frequencies could be greatly improved.

Since these baluns are used in most TV sets today, supply should be no problem. Various makes of sets were checked and part numbers obtained. Checks with the local distributors of the various brand sets disclosed that most stock the balun coils. However, since Standard Coil tuners are very widely used and since regular parts distributors stock replacement parts, Standard Coil part numbers are listed. The coil is stocked as an assembly and a few other parts which are not used in this application come mounted on the board. However, the price is still reasonable. Antenna Transformer, Standard Coil Part Number 31T-413, is the replacement part for the various Model "T" tuners and it sells for $1.90 net. The Antenna Input Assembly for the "FN" and "FD" series of tuners, Standard Coil Part Number 31T3398-01 or -02, sells for $1.15 net.

The photographs show a very convenient method of mounting the ferrite core TV balun. The case is a Bud 2¾" x 2⅛" x 1⅝" Minibox. An SO-239 coaxial connector is mounted on one end of the box with a ground lug secured under one of the mounting nuts. A dual, insulated binding post assembly is mounted on the other end of the box. The balun is wired between the terminals, supported by its leads. Although valuable in the shack, this unit is equally valuable in the shop for various balanced to unbalanced matching jobs.

. . . W4WKM

Parts Kit Available

Complete kit, including coil, box, SO-239 coax connector and screw terminals.

W4WKM-1 Kit (order from 73, Peterboro, N. H.) $3.00

Noise Limiter for CW

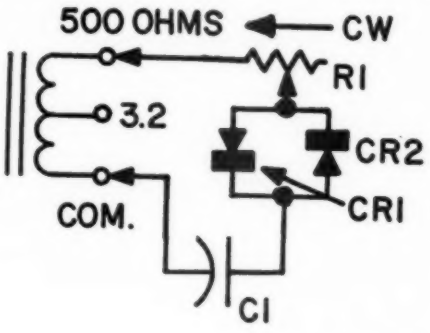
73 Parts Kit

Joe Williams W6SFM

The CW noise limiter shown in the diagram is useful with that type of receiver whose ANL works great on phone but which is next to useless when the set is operated in the CW mode. When connected as indicated, this accessory becomes a form of frequency selective short clamp. In most cases it won't be necessary to remove the receiver from its cabinet in order to make the hook up.

Operation

Since many CW operators prefer a tone of about 500 cycles, all signal and noise energy lying above that frequency within the audio image of the receiver can be trimmed without affecting the legibility of the code. With the diode noise limiter connected and with the receiver gain controls set at normal, the clipping



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Transceiver: 8¾" wide, 4¾" high, 7" deep. Weight: 7 lbs.-10 oz. Amateur net price **$349.95**

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control, R1, is advanced. When noise pulses of sufficient amplitude appear across the secondary of the output transformer, either or both of the diodes will conduct and a partial short circuit will be applied to the secondary through R1 and C1. C1 will, of course, exhibit less ac resistance at the higher audio frequencies and the threshold of avalanche of the diodes will occur earlier at those frequencies. This action takes the sting out of ignition noise, QRN and power line transients. When a noise spike causes the clamp to make, the entire audio product of the receiver is shunted for a few microseconds. The code tones being received will be perforated but unharmed. In severe noise, if the value of R1 is further reduced, the incoming CW signals will trigger the noise limited and the CW will chop holes in the noise with an action like that of a cookie cutter. This sounds a bit strange but often makes otherwise unreadable signals stand out so that they can be copied.

The Connections

Where the receiver has the familiar screw type connectors on the rear apron which are marked 500 ohms, 3.2 ohms and Common--the noise limiter is connected to the 500 ohm post and to Common. If your receiver has only a voice coil connection or has a self contained speaker, the limiter can be connected between the plate of the audio output tube and Ground. If this type of hook up is used, R1 should be 10K ohms and C1 should be a .47 mfd at 400 volts.

. . . W6SFM

Parts Kit Available

We've gathered the two diodes, pot and condenser into a package for you. Catalog price is $3.59 on the parts. W6SFM-2 Kit (order from 73, Peterboro, N. H.) $3.00

Errorless RTTY Converter

Jim Kyle K5JKX
1236 N. E. 44th Street
Oklahoma City 11, Okla.

Many RTTY converters, both with transistors and with vacuum tubes, have been described in the past few years. However, only one—the W2JAV unit—has taken full advantage of the 100-percent redundancy inherent in the RTTY code.

That term "redundancy," in case it threw you, is one bandied about by specialists in the field of information theory, and means simply that (in this case) you get two specific items of information at any given instant to tell you what the fellow on the other end sent.

It is inherent in any form of FSK, because if at any one instant a *mark* is being transmitted a *space* cannot be. If you receive both a *mark* and a *space* simultaneously, then something is wrong.

Thus, if our converters were designed so that we had signals available to indicate what was *not* being sent as well as what was, we could reduce errors by requiring both a *mark* and "not-space" to indicate a *mark*, and vice versa.

This, of course, is done in the W2JAV unit—but the converter described here, designed by use of symbolic logic and digital techniques

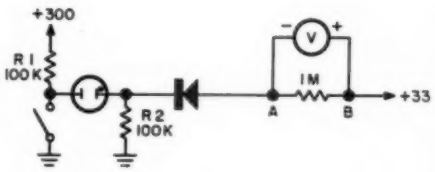


FIGURE 1

Fig. 1. Simplified schematic showing operation of "and" gates, with neon switches. Spst switch at left represents output stage of Schmitt trigger. With switched closed, neon goes out. Diode is forward biased and 33-volt supply flows to ground through 1-meg resistor, diode, and R2 in series. Meter reads approximately 30 volts across 1-meg resistor. With switch open, neon lights and approximately 100 volts appears across R2. Diode is reverse-biased and no current flows from 33-volt supply through 1-meg resistor. Meter reads zero volts. If left half of circuit (all components to left of point A) is duplicated and connected in parallel at point A, **both** switches must be open before current flow through 1-meg resistor is halted.

learned during a two-year bout with the computer industry, offers a few additional advantages.

Among these advantages are the fact that the printer is never allowed to run open, no tuning meter or scope is used yet immediate visual indication of proper tuning is given, and modern filter techniques together with efficient noise-pulse elimination permit copy under the most severe QRM conditions.

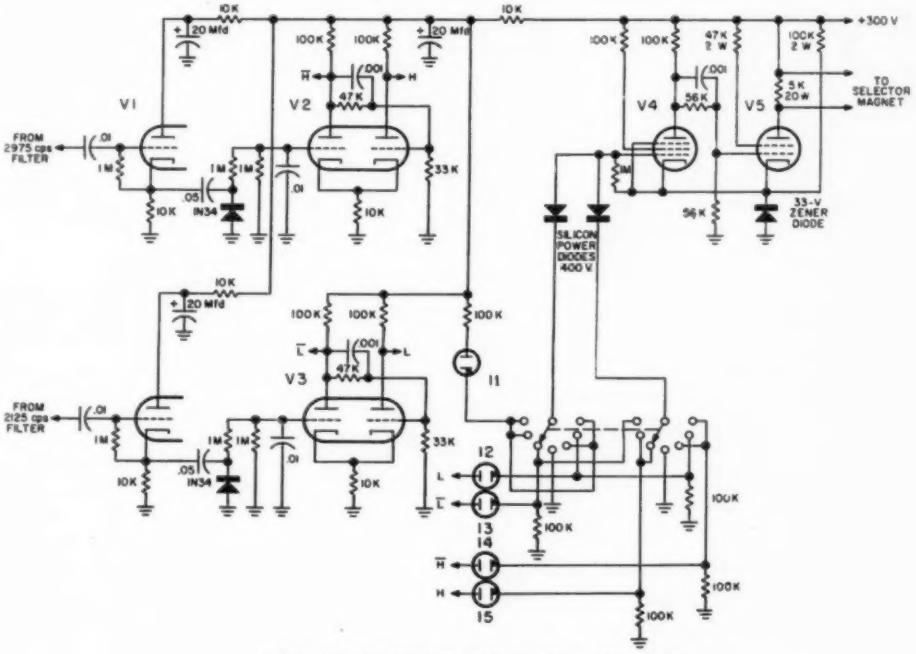
The never-run-open feature is brought about by holding the printer magnet energized at all times *unless* a specifically identified *space* signal is being received. When tuned off channel, tuning through a signal, or receiving only noise, the printer merely sits there.

Tuning indication is by means of a bank of four neon bulbs, which serve a double purpose. Originally included in the design to act as switches in the classic manner, they were brought out to the front panel when it was realized that they offered a valuable aid to tuning and troubleshooting in case of QRM.

Since a seven-position front-panel switch offers the option of "bilateral" (a term invented here to describe the *mark*-plus-not-*space* requirement) copy, *mark*-only copy, or *space*-only copy in both normal and inverted positions, as well as a seventh "no copy" position to insure absolute quiet while tuning under difficult QRM conditions, versatility is about as great as could be hoped for. Though the switch makes things look complicated, it is actually simple to wire in due to the digital circuits employed.

The heart of this converter is the combination of the neon switches and the "and" gate. Fig. 1. is a simplified schematic showing how this works; only one neon and one diode are shown.

The spst switch at the left of the illustration represents the output section of the associated



SCHEMATIC DIAGRAM OF DIGITAL RTTY CONVERTER
FIGURE 2

Switch Positions:

1—Mark only
2—Space only
3—Bilateral
} Mark low

5—Bilateral
6—Space only
7—Mark only
} Mark high

4—No copy

V_1, V_2, V_3—12AX7
V_4—6AU6
V_5—6EM5
I_1, I_5—NE2

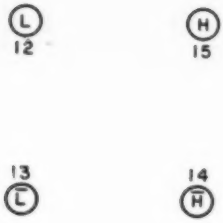


FIGURE 3

VISUAL TUNING INDICATOR PATTERN LAYOUT. SEE TEXT FOR DETAILS.

Schmitt trigger tube and will be either open or closed. Acually, with the values given on the full schematic, about 15 volts will appear at the upper end of the "switch" when it is "closed" but for purposes of explanation it is close enough to a dead short.

With the switch closed, not enough voltage is applied to the neon tube to allow it to fire so it stays dark. Under this condition, the diode is forward biased by the 33-volt supply, and current flows through the 1-megohm resistor, the diode, and R2, all in series. Approximately 30 volts are developed across the 1-megohm resistor by this current flow.

With the switch open, however, current from the 300-volt supply fires the neon tube and it lights. This allows about 100 volts to be developed across R2, which reverse-biases the diode. With the diode cut off, no current can flow through the 1-megohm resistor, and no voltage is developed between points A and B.

If another diode, neon, switch, and two 100K resistors are added to duplicate the left-hand part of the circuit, connecting the added duplicate circuit to point A also, then current can flow through the 1-megohm resistor if either of the spst switches is closed. Only when *both* are open will the voltage from A to B drop to zero; at all other times it will remain at about 30 volts, and point A will be negative with respect to point B.

In the complete converter, point A is connected to the grid of a pentode tube (V4) which forms half of a third Schmitt trigger while point B is connected to the cathode. The tube chosen, a 6AU6, cuts off at considerably less than -30 volts, so that it remains cut off at all times except when both switches are closed.

But at this point, we're a bit ahead of our explanation of the way this gadget works. Let's back up a bit, like all the way back to the receiver.

The complete schematic of the converter, Fig. 2, does not show the input amplifier or the filters. This is because they are not particularly critical. No limiter is necessary, but a band-pass filter from 2 to 3 kc is a definite asset. My own preference is for the 5-section filter described earlier in these pages, fed by a 6J6 operated grounded-grid for simplicity—but even a single-section toroid will surprise you when used with this converter following it, because of the extremely light loading presented by the detectors of Fig. 2.

The first stage shown in the schematic is a dual cathode follower, using half of a 12AX7 in each channel. This is used primarily as an impedance-matching device to prevent the diode detectors from loading the filter outputs.

The 1N34 diode detectors are fairly conventional except that they are connected to give positive-going output with signal. The two 1-megohm resistors and the .01 mfd capacitor between the diode and the following-stage grids form a time-delay filter which prevents noise pulses from triggering the following circuitry. Both attack and release time constants are 10 milliseconds; this is long enough to allow positive operation on standard RTTY pulses while rejecting all ordinary forms of noise.

Since the circuits of V2 and V3 are identical, only one will be described. These are Schmitt trigger stages, which have the property that only one of the two triode sections of the tube will conduct at a time. Assuming that the input half of V2 is conducting, its plate voltage as measured at the plate itself drops to about 15 volts. Voltage divider action through the 47K and 33K resistors drops this to only about 6 volts at the grid of the output half. At the same time, about 25 volts develope across the common cathode resistor due to current flow in the input half. The resulting -19 volts from grid to cathode of the output half cut this side off, and plate voltage rises to 300.

When the input half stops conducting, its plate voltage begins to rise. The positive-going pulse at the plate bypasses the 47K resistor through the .001 mfd capacitor and drives the second half into conduction. This increases total current flow through the cathode resistor, increasing cathode voltage and thus helping cut off the input half. When all current flow stops in the input half, the positive voltage developed through its plate resistor, the 47K, and the 33K resistor all in series help maintain conduction in the output half.

Thus you can see that the output half is conducting unless an external signal forces the input half to conduct, and when this happens the output half ceases to conduct. In consequence, we have a high voltage at the plate

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of the input half and a low voltage at the output plate in the absence of driving signal, and the reverse when a signal is present. One of the two halves is conducting at all times.

This situation is noted on the schematic by marking the lead from the plate of the output half of V2 "H" for high-frequency-signal-present, and the plate of the input half "not-H" (denoted by a bar over the H on the drawing), for high-frequency-signal absent.

Similarly, the corresponding plates of V3 are marked "L" and "not-L".

The "H", "not-H", "L", and "not-L" signals obtained from V2 and V3 are fed to the neon-switch and "and" gate section whose basic operation was described previously. A brief bout with symbolic logic equations which won't be repeated here showed that it would be necessary to use the "H" and "not-L" signals together to identify a mark-low *space* signal, and the "L" and "not-H" signals similarly for mark-high copy. Under any other possible combination of input signals, we want the printer magnet to hold in the "mark" position.

However, to allow copying from the *mark* or *space* signals only, in case the other side of the signal is jammed by QRM, we must be able to defeat the bilateral feature. This is accomplished by I1 and its associated resistors, which furnish a "fictitious" "H" or "not-L" signal is required.

The seven-position switch selects the proper combination of input signals so that the "and" gate will allow V4 to conduct whenever a "space" signal is being received and at no other times. In the "no-copy" position V4 is permanently cut off.

Both V4 and V5 are part of a power Schmitt trigger which includes the printer magnet itself as its output load. When V4 is cut off, it holds V5 in conduction and the printer magnet is pulled in. When V4 conducts, its plate voltage drops so low that V5 is cut off, and the magnet drops out. The 5K resistor swamps inductive surges from the magnet, while the Zener diode holds cathode voltage fixed at 33 volts postive. A stiff voltage divider might do as well, but the plate current of V5 is something like ten times that of V4 so the Zener is a worthwhile investment.

Magnet current may be set, if desired, by adjusting the value of the screen resistor of V5. I operate my Model 15 at anywhere from 18 to 45 MA without troubles.

Power requirements for this converter are relatively modest, but it should have its own supply. A 100-MA supply will be more than ample. Regulation of the supply is not critical; any small receiver-type transformer should do.

Now to get back to that visual tuning we mentioned once and never came back to. It revolves around the four neon-switch bulbs 12 through 15. If they are arranged in a pattern similar to that shown in Fig. 3, the light pattern itself will indicate proper tuning.

When no signal is coming through either channel, both "not" bulbs (13 and 14) will light and the pattern will be a horizontal bar across the bottom of the square.

In the rare event of QRM in both channels, both "true" bulbs (12 and 15) will light and the bar will move to the top of the square. This is a most improbable pattern to observe.

A steady carrier or tone in either channel will cause the upper bulb in the associated channel to light. For instance, steady carrier in the upper channel would cause 15 to light but would not affect 12 or 13.

Normal frequency of RTTY pulses is about 23 cps; the eye cannot detect pulses faster than about 18 cps. Thus, an incoming RTTY signal properly tuned will make *all* four bulbs appear to be lit simultaneously. The receiver can be tuned for this condition with the converter switch in "no copy," and a flick to either "mark high bilateral" or "mark low bilateral" should result in perfect copy.

Should you be hit by a QRM, a glance at the lights will tell you whether it is in the upper or lower channel; you can then operate the switch to continue copy from the remaining clear channel.

If you want to operate several pieces of equipment from this converter, it's easy to do so. Simply *parallel* all the magnets. Use a 5K resistor at each magnet, to absorb the inductive kicks. That's it—and happy *digital RTTY!*

. . . K5JKX

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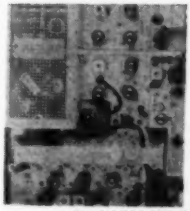

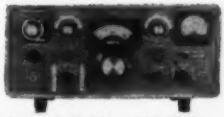

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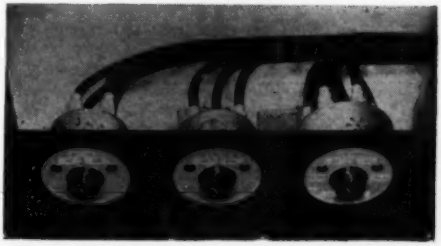

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The Bourbon S-Meter

73 Parts Kit

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Santa Barbara, Calif.

This article bears its rather strange title because the author is tired of hearing reports from other amateurs who say they are using Scotch S meters.

Seriously, the point of this article is to tell those who have receivers with no S meters how to install S meters. The process is easier than you think. We should also mention that the material presented herein is not new; this article is simply a refresher course in S-metermanship.

S meters perform a number of valuable functions, such as observing changes in signal strength as a beam is rotated, aligning the receiver, and as a basis for lying to another station regarding his signal strength. There are many receivers in use today, either surplus or home built, which do not have S meters. Installation of an S meter in most of these receivers (providing they have an avc and the avc is working) is relatively simple.

The basic S meter bridge circuit is shown in Fig. 1. You can build the gadget in a 5" x 2¼" x 2¼" minibox. There will be four leads going to the receiver from the S meter: ground, filament voltage, plate voltage, and avc. A Jones Type AB male connector can be mounted on the box and a Type AB female connector on the receiver, with a cable between using corresponding connectors. Or, if you want to—and have the room—you can build the unit right into the receiver.

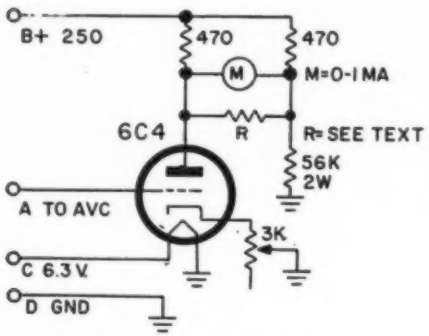

FIG 1 BRIDGE S-METER CIRCUIT

The meter is a 0-1 milliameter, either a Shurite Model 850, or similar inexpensive meter. Several of the amateur radio supply houses stock reasonably priced meters manufactured in Japan which are quite adequate for this purpose.

The thing that scares a lot of hams away from attaching an S meter to their receiver is that they don't know how to identify the avc line. Avc means, of course, automatic volume control. Perhaps a more accurate term would be "automatic gain control," but either way this is how it works: the average rectified dc voltage, developed by the received signal across a resistance in the detector circuit, is used to vary the bias on the rf and *if* amplifier tubes. This voltage is proportional to the average amplitude of the signal so the gain is reduced as the signal strength becomes greater. Thus, the avc tends to keep the receiver output level relatively constant, regardless of input signal. The more stages controlled by the avc, the better the control, and the more constant the gain will remain.

Fig. 2 shows a typical avc circuit. By referring to the schematic for your own receiver (if you don't have one, do your best to get one—they're mighty handy) you should be able to easily locate the avc line. If you have no schematic, you can find the avc line by remembering that the identifying characteristics of the line are that the grid resistors from the controlled stages (usually one or more *if* and rf stages) are all connected to a common line which connects, through a resistor, to a diode—most often one of the diodes in a dual-diode-triode tube.

Now, getting back to our S meter circuit, this is the way it works: the voltage developed by the avc circuit is very nearly a logarithmic function of the incoming signal, so if the S meter tube plate current is proportional to the

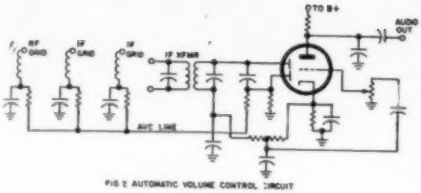

FIG 2. AUTOMATIC VOLUME CONTROL CIRCUIT

grid voltage, the meter will read according to a linear decibel scale. This means that readings won't all be bunched up at one end of the meter scale. This meter, when adjusted as we will describe, will handle a signal range of around 80 db.

Having located the avc line, provided for the necessary four connections, and constructed the S meter, we can now attach, in the receiver, connection A to the avc line, B to B+ (approximately 250 volts), C to the 6.3-volt filament circuit, and D to chassis ground. Don't put the 6C4 in its socket just yet. Turn on the receiver and adjust the resistor across the meter until the meter reads full scale. The value of the resistor, which will probably be in the neighborhood of a few ohms will depend upon the internal resistance of the meter unit.

Then, having arrived at the proper shunt resistance, put the 6C4 in the socket, allow it to warm up, and, with a short length of wire or a clip-lead, short the avc line to ground so that the 6C4 grid will be grounded. Adjust the 3000 ohm potentiometer until the meter reads zero. Now disconnect the avc from ground. The meter will now follow signal variations up to the point at which the voltage is high enough to cut off the 6C4 plate current.

Now to calibrate the meter. Assuming that a full-scale reading on the meter is an 80 db, signal, and that, since S meter units are usually considered to each be equal to six db, S9 will equal 54 db, with each tenth of a milliamp division equalling eight db. S9, then occurs at 0.675 ma, 0.7 is two db over S9, 0.9 is 18 db over S9. (By George, this *is* a stingy S meter!)

If you would like to give higher signal reports and thus make more friends (the degree of friendship increases as the square of the signal report given by the receiving station), at the sacrifice of accuracy, just multiply the figures given above by any factor you desire!

. . . W6TKA

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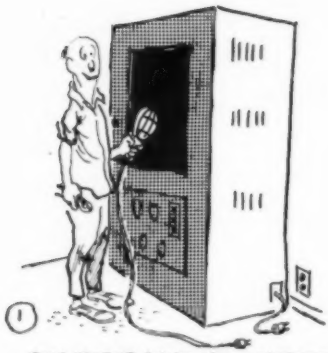
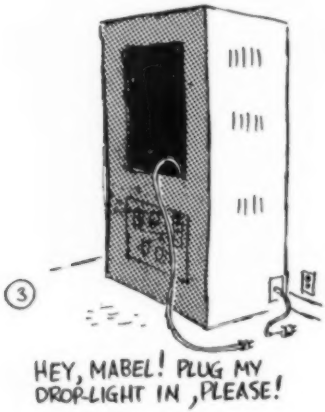
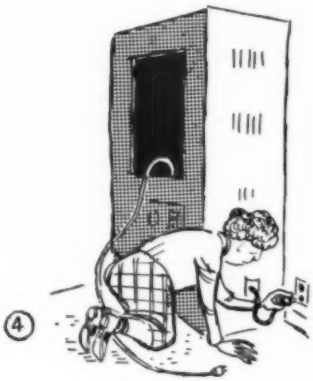

1
BOY, THESE KING-SIZE CABINETS ARE THE CAT'S-MEOW!

2
NO TROUBLE TRACING CIRCUITS WITH THIS RIG...


3
HEY, MABEL! PLUG MY DROP-LIGHT IN, PLEASE!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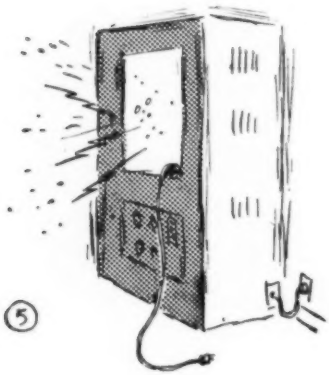
5

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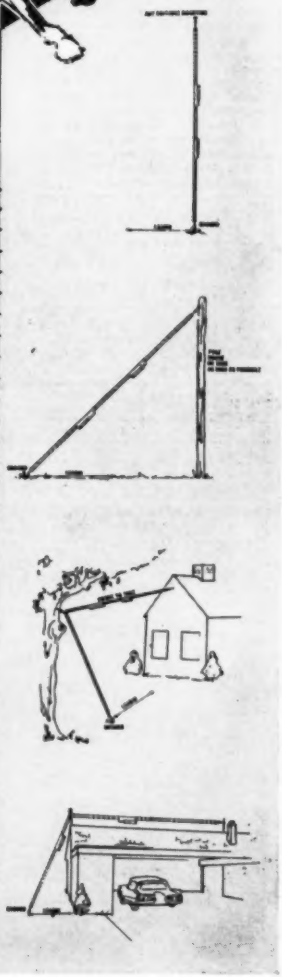

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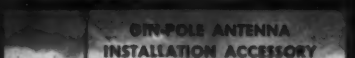
ILLUSTRATED MODEL NUMBER	HEIGHT	PRICE (STANDARD FINISH)
HM-354 (3 sections) and TBC	Extended: 54' Collapsed: 20'-1"	$425.75

NOTE THESE WIND LOAD CAPABILITIES: (Based on a six foot mast above the tower, with the center of the antenna at the top of the mast: i.e. 60 feet above ground.)

UNIFORM BUILDING CODE WIND PRESSURE	ANTENNA projected area
20 lbs./sq. feet	10 sq. feet
30 lbs./sq. feet	5 sq. feet
L.A. City Code (Strong Winds and Earthquakes)	10 sq. feet



Tri-Ex TOWER CORPORATION
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Towers

Val Barnes K1AFA

Hams press almost anything into service to hold up their antennas. Chimneys, trees and telephone poles may be used a lot, but there is nothing quite as satisfactory as a good tower. In years gone by a ham had to either build his own out of available materials (latticework or ladders) or else try to find an old windmill or broadcast tower. The advent of fringe area television and burgeoning commercial services have brought many manufacturers into the economy tower making business. You can now buy a complete tower with guys for just about what you would have had to pay for food to biuld your own rickety monstrosity a few years back.

Perhaps you've held back on buying a tower because you are worried about getting it erected. Well, I've proven rather conclusively that you can pick two hams at random with no previous experience and still get just about any ham tower up in the air in a few hours. Using unbelievably incompetent help I've recently erected a 120 foot tower, then used it to remove a 64 element two meter beam from a nearby 100 foot tower. Then I took both towers down and set them up again at the 73 Mountain VHF Station, along with two other 60 foot towers and a new 100 footer. My main helper in most of this is a ham we all call Goat Boy because he spends a great deal of his time butting heads with our pet goat. He's ahead, but his attention seems to wander a lot these days.

Towers. Before buying you'll want to make the decision about whether you are going to buy a crank-up type or a regular un-crank-up type. If you like to make adjustments on beams or change antennas every now and then without risking a nasty fall you should eye the crank-ups.

Though several manufacturers have designed their towers to stand up without guys (some up to 70 feet), it has been my experience that most hams eventually put more on top of the

MANUFACTURER	MODEL	TYPE	MAX. HGT. FT	MIN. HGT. FT	VERTICAL MEMBERS (INCHES)	WIDTH AT BASE (INCHES)	WEATHER PROOFING	AV. COST $/FT	TOTAL COST	WGT. (LBS)
E-Z Way	6046	CU TO	60	26	---	---	HD galv.	5.40	324	---
	HD-40	CU TO	40	24	0.84 OD	8.5	Al. Enamel	2.48	264.00	400
	RBS-40	CU TO	41	25	1.05 OD	10	Al. Enamel	4.14	244.50	350
	RBX-40	CU TO	41	25	1.32 OD	14	Al. Enamel	5.32	350.00	488
	RBS-50	CU TO	51	35	1.05 OD	10	Al. Enamel	4.38	314.50	418
	RBX-60-3	CU TO	60	25	1.32 OD	14	Al. Enamel	5.58	455.00	610
	RBX-70-3	CU TO	73	30	1.32 OD	14	Al. Enamel	6.64	730.00	861
	G10	SS	210	10	1 OD	9.75	HD galv.	2.55	404.20*	430*
	G40	SS	300	10	1.25 OD	16	HD galv.	3.65	517.60*	660*
	HP-34	SSNG	34	34	---	9.75	HD galv.	2.20	84.95	---
Heights	A120	SSNG	120	8	Aluminum	26, 11	none	6.87	894.00	329
KTV	1200-G	SS	130	10	1 OD 14 ga.	12	HD galv.	2.75	537.20*	498*
	1600	SS	130	10	1 OD 14 ga.	16	HD galv.	3.25	593.23*	454*
	1600-XX	SS	130	10	1 OD 14 ga.	16	HD galv.	4.00	673.20*	606*
Mosley	100	CU HB	105	21.5	---	17.6	Epoxy Resin	---	510.51	395
	300	CU HB	88	21	---	20.6	Epoxy Resin	3.54	440.11	390
	400	CU HB	37	20.3	---	14.75	Epoxy Resin	3.92	208.66	165
	500	CU HB	88	21.7	---	26.6	Epoxy Resin	5.42	698.80	620
	600	SS NG	50	50	1.66 OD x .128	28	Epoxy Resin	6.50	324.95	445
	650	CU TO HB	54	21	---	---	Epoxy Resin	6.86	515.90	935
	700	CU TO HB	71	21.5	---	---	Epoxy Resin	11.45	1009.90	1745
	750	CU TO HB	71	21.5	---	---	Epoxy Resin	14.00	1189.90	1785
Rohn	6	CU	71	20	1 OD 14 ga.	14.5	HD galv.	3.98	395.60	370
	25	TO	48	21.5	1.25 OD 16 ga.	12.5	HD galv.	5.63	207.10	350
	25	SS	280	10	1.25 OD 16 ga.	12.5	HD galv.	2.61	402.95*	513*
	45	SS	350	10	1.25 OD	16.75	HD galv.	4.89	706.90*	884*
Supreme	40-1	CU	40	23	1.12 OD 17 ga.	8.75	Al. Paint	2.97	129.00	132
	40-2	CU	40	23	1.12 OD 17 ga.	8.75	Al. Paint	3.72	159.00	140
	40-3	CU	40	23	1.12 OD 17 ga.	8.75	Al. Paint	5.97	253.50	170
	60-4	CU	60	24	1.12 OD 17 ga.	11.25	Al. Paint	6.57	414.50	350
	60-5	CU	60	24	1.12 OD 17 ga.	26.5	Al. Paint	11.56	695.00	425
Tristao	100	CU HB	105	21.5	---	17.6	Epoxy Resin	3.32	476.31	395
	300	CU HB	105	21.75	---	23.5	Epoxy Resin	3.89	593.17	520
	400	CU HB	105	22	---	26.6	Epoxy Resin	5.72	817.40	790
	500	CU HB	105	22.5	---	30.5	Epoxy Resin	7.46	1073.65	890
Tri-Ex	HM-354	CU TO HB	54	20	1.5 OD x 0.12	23	HD galv.	9.43	509.00	850
	SX-6105	CU HB	105	21.8	1.25 OD x .083	27.6	Epoxy Resin	9.87	1124.83	1030
	HM-237	CU TO HB	37	20	1.500D x 0.12	23	HD galv.	7.40	359.95	385
	HS-6105	CU HB	105	20	1.250OD x .083	24.75	Epoxy Resin	8.07	951.27	870
	H-471	CU HB	71	20	1.25 OD x .083	19.37	Epoxy Resin	4.41	387.24	365
	T-588	CU HB	88	21	1 OD x .065	13.87	HD galv.	2.53	426.55	280
	10	SS	120	10	1 OD x .065	14	Epoxy Resin	2.51	612.57	485
	EMPIRE	CU HB	46	20	16 ga.	---	HD galv.	2.42	205.01	176
Vesto	VHP	SS NG	100	22	2.5 x 2.5 L	---	HD galv.	13.12	1312.00	3000
WRL	SPIRE JR	SS NG	8	8	U Channel	34	galv.	2.12	16.95	---
	SPIRE	SS NG	32	32	U Channel	19.75	galv.	1.56	49.95	115
	SPIRE	SS NG	40	40	U Channel	22.3	galv.	1.81	72.25	160
	SPIRE	SS NG	48	48	U Channel	25	galv.	2.20	105.50	230

CU TO = crank-up, tilt over
SS = self-supporting
SS NG = self-supporting, no guys
CU HB = crank-up, hinged base

CU = crank-up
HD galv. = hot-dipped galvanized
AVERAGE COST = exclusive of guys, base, etc.
*Computed for 100 foot tower.

tower than the manufacturer had in mind when he calculated wind loads and it is well worth the added expense and bother to put in some guys. You can guy the tower to trees, houses or even screw anchors which all the tower companies have available. With a little extra effort you can use the guys as an inverted V antenna for the lower frequencies.

The minimum height of a tower is either the cranked-down height or else the length of one section of a regular tower. The size and gauge of the vertical legs gives you a good indication of the strength of the tower. The leg-to-leg distance is the width at the base. Crank-up towers naturally are smaller at the top since each section slides down inside the one below it.

If you have a rigorous climate you may pay more than passing attention to the finish. The hot-dipped galvanized is a bit more durable and thus is more expensive.

The cost-per-foot does not include guys and other accessories and is thus merely a relative figure. The total cost of the tower does include everything.

Many manufacturers can supply special top

sections to fit just about any commercial rotor. KTV has an arrangement for cranking your rotor and beams up and down the side of the tower called Hy-Track.

When you consider that raising your beam even thirty feet can make a world of difference it is worth while to take a close look at this chart. About the only tool you'll need that is special is a "gin" pole and this can be bought or borrowed from most tower companies. If you are going to do any great amount of high work you might do well to invest $17 in a lineman's belt or else hound the surplus houses until you find one at a bargain.

We have one tilt-over crank-up tower and it is a great comfort, though I must admit to a slight wince at the initial cost. This is mighty handy for us when we get in a new antenna to test out. It only takes a few minutes to go out and crank it down, then over so we can remove the old antenna and install a new one. Inside of a half hour it is back up ready to use.

While most tower manufacturers are extremely helpful and have interesting and educational literature, you may have as much trouble as we did with a couple. Good luck.

Institute of Amateur Radio

Membership in the Institute is growing rapidly. Yearly membership costs only $1.00. Purpose: to make ham radio more fun. Programs: Group trip to Europe in October. Protection of minority groups (such as ham-TV'ers who are trying to open frequencies on two and six for experimental purposes; ARRL opposed(. Protection of minority groups (such as General and Conditional Class licensees who have suddenly found that they need protection). Establishment of communications between all amateurs, the FCC, the ARRL, government agencies, etc. We desperately need your help, won't you join? Send your name, call and address with $1 to Institute of Amateur Radio, Peterborough, N. H.

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ASK THE HAM WHO OWNS ONE

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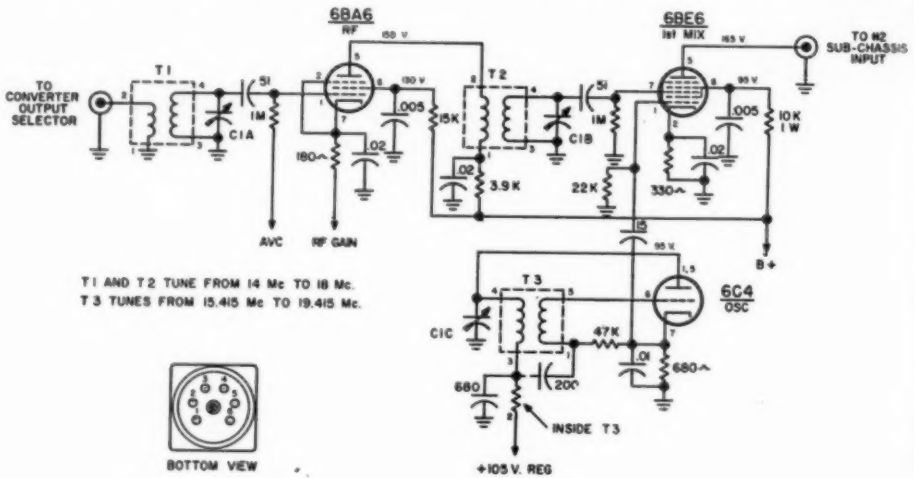
Wichita 17, Kansas

A VHF Receiver

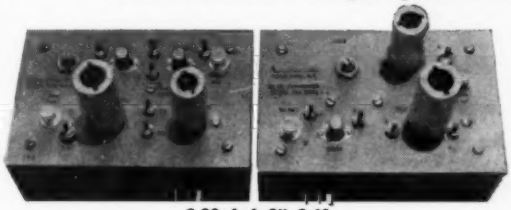
For some time I had been using the ten meter band on my receiver as a tunable *if* for a six meter and two meter converter. This mode of operation tied up the ten meter band and limited my coverage on the VHF bands. The idea began to dawn that what I needed was a separate VHF receiver capable of covering the full four megacycles of the six and two meter bands. The receiver described in this article consists of a tunable *if* covering a four megacycle range from 14 mc to 18 mc. Detectors are provided for AM, CW and SSB. Controls include audio and rf gain, noise limiter, SSB/CW-AM mode, avc, and selection of either a six or two meter converter or tunable *if* input. The approximate cost of the receiver including the two VHF converters and all new components will be less than $200. A minimum of



#1 SUB-CHASSIS VHF RECEIVER
14 Mc-18 Mc TO 1415 Kc IF

OVERLOAD? NOISE? CROSS-MODULATION?

Not with the Amplidyne Nuvistor Converters



C-23 4x6x2" C-61

	C-61	C-23
Input	50-54	144-148
Noise figure	2.5db	3.0db
Gain	25db	30db
Output	14-18mc standard (any other $1 additional)	
Impedance	50 ohms	50 ohms
PRICE	$28.50	$34.25

ADJUSTABLE I.F. GAIN, TRIODE MIXER, .005 XTAL INSIDE CHASSIS TO PREVENT DRIFT, 6CW4 GROUNDED GRID R.F. AMPS

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220 & 432 nuvistor converters

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KINGS PARK LI NY

BOX 673

Write for technical info

tube types were used in order to keep tube inventory reasonable. Some of these new receivers use a different type tube for each stage of the set. Although the junk box collection for this project was started over a year ago the construction took about a month and a half of evenings and weekends. Assembly of the two commercial VHF converters required about six evenings of time.

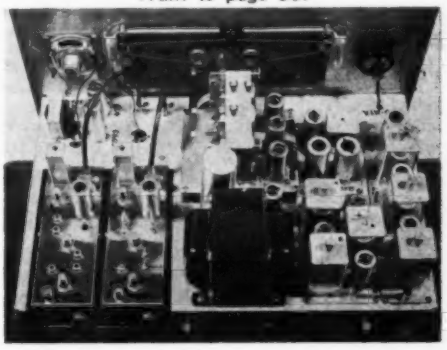
Circuit Description

The receiver circuitry begins with an AMECO six or two meter Nuvistor equipped converter whose output covers the 14 mc to 18 mc band. A selector switch controls the B+ to each converter and the appropriate rf output to the input of the receiver. The receiver consists of four sub-chassis. The first is a tunable front end covering 14 mc to 18 mc whose output is 1415 kc. The second sub-chassis amplifies the 1415 kc signal through one stage of *if* and converts it to 239 kc. The third sub-chassis consists of two stages of low frequency *if* amplification and an AM detector, avc detector, and the ANL stage. The fourth sub-chassis includes the SSB/CW detector, bfo and the tuning meter detector. The power supply and audio stages are located on the main chassis.

Construction

Two surplus ARC-5 command type receivers were acquired for junking purposes. These two units covered the range from 3 mc to 6 mc, and 6 mc to 9 mc. The tuning condenser and the associated coils were removed from the 6 mc to 9 mc unit for use in the first sub-chassis. The gear mechanism was removed from the tuning condenser. All the rotor plates but two were pulled from the rf and mixer sections of the tuning condenser. Three rotor plates were left on the oscillator section. The rotor plates with all the slots that are used for tracking purposes

(Turn to page 30)



NEW!

An Economy Converter

6M . . . . . ONLY $31.95

Dear OM:

There are quite a few VHF converters on the market today. Some of them are pretty good, some are unbelievably terrible. After looking over the available converters we decided that we could do better. We have. Only a ham could afford to put the months of lab time into the development of something like this, trying every known circuit and testing each under the worst possible ham band conditions.

We reached several interesting conclusions as a result of all this research. 1) The noise figures claimed for several brands of converters seem to have been determined in advertising departments instead of labs. 2) If it doesn't work too well, gold plate it. 3) It is standard practice to use the cheapest parts available even if it does reduce the life expectancy of the converter or cut down on its performance. 4) Some converters were obviously thrown together from old magazine articles and there wasn't even a sign that an engineer had been near them. 5) There should be a market for a well engineered converter.

Naturally, for our own use, we pulled out all the stops and built the last word in state-of-the-art VHF engineering. When we figured out what it cost to build this converter we could see that this wasn't going to be very popular. Not many hams are going to spend $98.50 for a converter, no matter how unbelievably it performs. After all, how many hams are so avid about working DX that they want to pull extremely weak signals out of the noise? Just a handful of meteor-scatter addicts, aurora hounds and the like would ever need the gain and the rejection of adjacent signals that our DGC models afford.

Matching Power Supply HJS $9.95

Delivery Date, Sept. 1

You can't put units like our DGC Converters on the market and sell enough to stay around. Which thought sent us back to the workbench and eventually brought about the economy converter, the model HJC-50. This one is designed to compete with any other converter on the market price-wise and we are sure enough of its operation to give a money-back guarantee that it will outperform any other commercially made converter, regardless of price, except our DGC units. The HJC-50 uses a nuvistor front end for low noise figure. It is crystal controlled for stability. The HJC-50 is designed to be used with 14-18 mc receiver tuning. Thus you can tune the 50.0-50.4 mc band even if you only have a ham-band only receiver which tunes from 14.0-14.4 mc, and this covers virtually all of the presently used six meter band.

These converters are available by direct mail order only. This is necessary if we are to maintain our low price. The model HJC-50 converters are now in stock for imediate delivery and all orders will be filled the day received. The DGC converters are custom built to your specifications. Please, if you must have one of these, specify the band it is to cover (50-144-220-432 mc) and the i-f output frequency. We will build your unit and individually test it, furnishing you the test result certificate and customizing it with your call engraved.

The DGC converters are built into a solid aluminum extruded case which can be used on the operating table or else mounted on a rack panel. It is attractively finished in bright red and black. It is entirely nuvistorized, using the new 6DV4 (hang the expense) for the front end.

The HJC converters are available in the 50 mc model at present, with higher frequency models in the works. Watch for our ads. We have a lot more gadgets just about ready for production too.

Val Barnes K1APA & Sam Harris W1FZJ

CUSTOM MADE

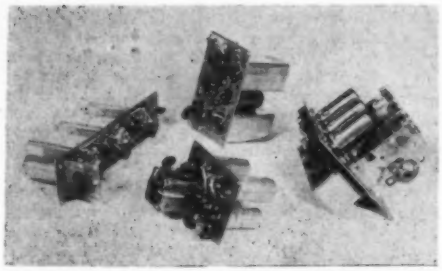
Money Is No Object

Converter

DGC-50	**98.50**	**These units are individually made to your specifications. Please state band and desired output i-f.**
DGC-144	**98.50**	
DGC-220	**98.50**	

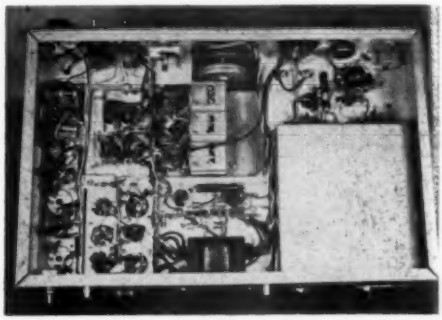
REDLINE

Jaffrey, New Hampshire

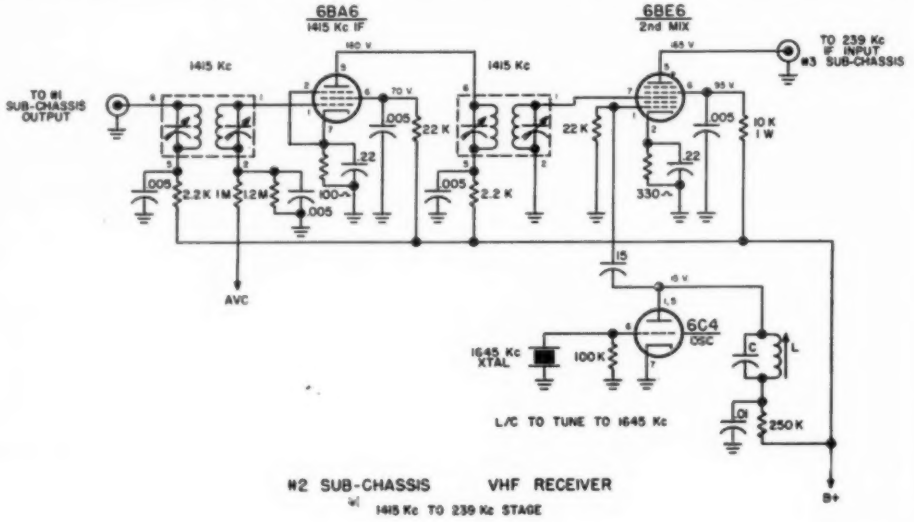


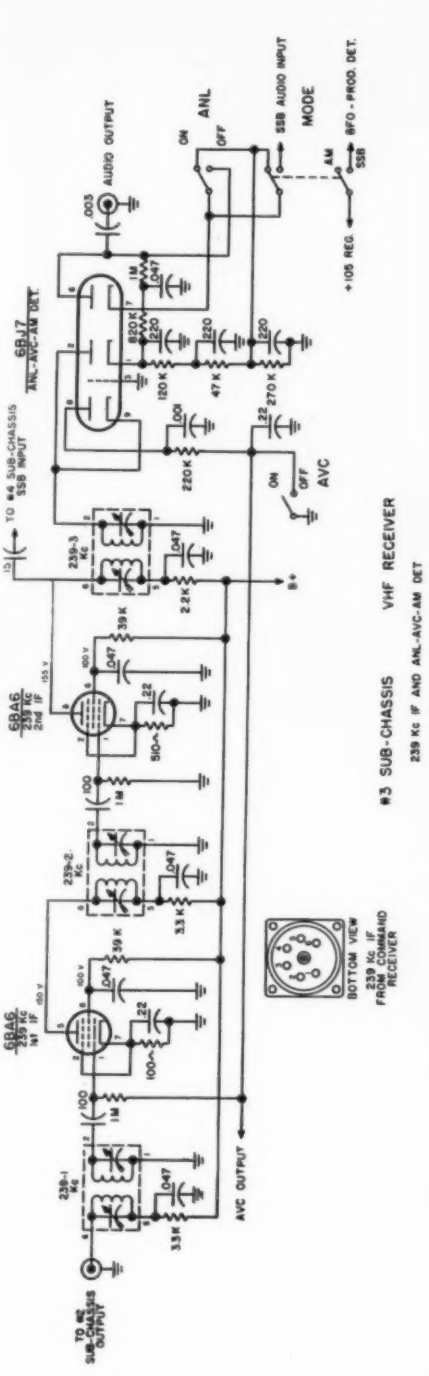
were left on the rotor also. The oscillator, mixer and rf grid coils were modified by removing half the turns plus one. The original *rf* coil was connected to the antenna through a coupling condenser. This coil is further modified by adding a new antenna winding over the cold end of the coil for antenna and ground connections. This coil is made from some of the wire removed during the above changes. It consists of about five turns. The tuning condenser comes equipped with trimmer condensers for the oscillator and mixer sections but none for the rf section. An Erie 7-45 mmf trimmer was soldered across the rf tuning section of the three gang condenser. One end was soldered to the stator and the other end soldered to the frame of the tuning condenser. This will provide trimming adjustments for all three stages of the front end to aid in tracking.

The modified coils were then replaced in their shield cans and each one breadboard connected to the three gang condenser to check for proper frequency coverage. The rf coil and mixer coil were checked for proper frequency coverage using a Grid Dipper. The oscillator circuit was tacked together and the frequency coverage checked with a Frequency Meter. The oscillator must cover from 15.415 mc to 19.415 mc, if a 1415 kc *if* is to be used. The rf and mixer coils must cover the 14 mc to 18 mc of course. The powered iron slugs found inside the coil forms were backed off until they were almost to the end of their travel. The trimmer condensers on the three gang tuning condenser are used to set the high frequency end of the dial, and the slugs are used to set the low frequency end of the dial. As would be expected in any coil tracking job there is interaction between adjustments.



The 1645 kc oscillator coil on the second sub-chassis was constructed from a salvaged slug tuned coil form and mounted in one of the scrapped Command Receiver *if* cans. Its resonant frequency was determined by a Grid Dipper. After I was fairly well along with this sub-chassis one of my ham visitors quietly men-

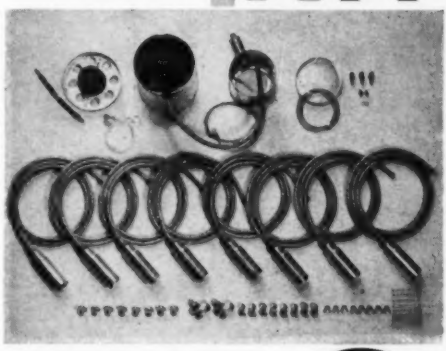




eliminate ignition system interference

webster band-spanner.

ELECTRO SHIELD KIT



ELECTRO SHIELD prevents radiation—stops ignition noise at its source—by completely enclosing the entire ignition system, coil, plugs, distributor. **Entirely mechanical,** no phasing or filtering.

Now in kit form for substantial saving! Complete as illustrated. New cap and total shield for distributor—coil shield and filter—plug shields and leads. Snap-on plug connections are **swaged**—won't pull out or loosen. Plug shields have molded inserts which eliminate sparkover also waterproof plug. Kit includes all necessary hardware and full instructions. Typical installation is shown in circle.

Two kits available for 8 cylinder cars:
For '57-'63 Buick, Cadillac, Chevrolet, Corvette, International Harvester, Oldsmobile, Pontiac and Rambler.
MODEL 5500-DR-8
For '57-'63 Ford, Mercury, Lincoln, Thunderbird.
MODEL 5500-F8

Complete assemblies available for most 6 and 8 cylinder cars, also 4 cylinder VW's.

kit 49.95 Plus F.E.T.

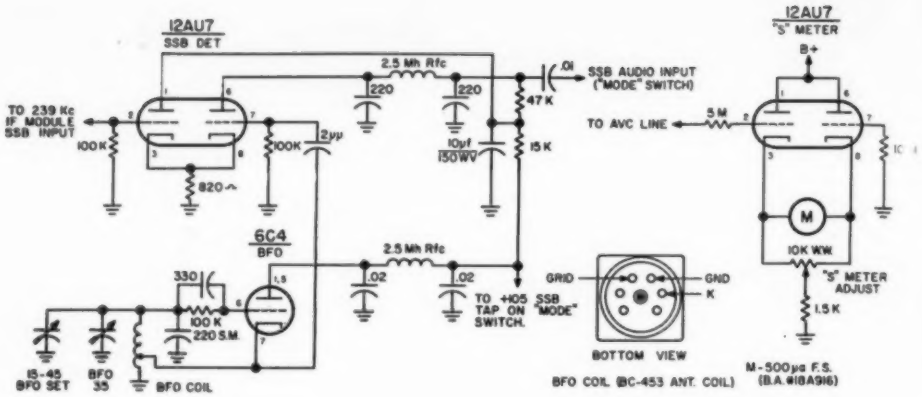
Please send information on Electro-shield and Band-spanner antennas and mounts.

Name_____

Number Street

City Zone State

BAND-SPANNER 317 Roebling Road, South San Francisco, Calif.

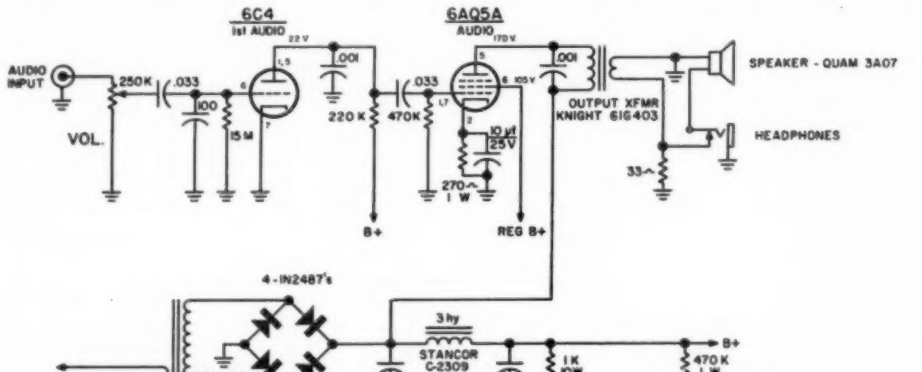


#4 SUB-CHASSIS VHF RECEIVER

PRODUCT DETECTOR-BFO-"S" METER

tioned that there was a broadcast station on 1410 kc in the vicinity. This resulted in some head scratching and scheming to keep wire lengths short for minimum spurious pickup and I was most happy to find no birdies from that station in the final product. When the third sub-chassis was finished wiring I hooked it up to a power supply and signal generator for *if* alignment. After this stage was aligned the second sub-chassis was temporarily connected to the third sub-chassis and given a checkout and preliminary 1415 kc alignment.

The bfo and product detector section gave me the most trouble. The original circuit used a 6BE6 product detector but I could not get it to function as I thought it should. The sub-chassis was removed from the main chassis and modified to use the old reliable 12AU7 double triode product detector circuit. The bfo coil was made from the rf coil removed from a BC-453 Command Receiver that had been salvaged in previous construction projects. The

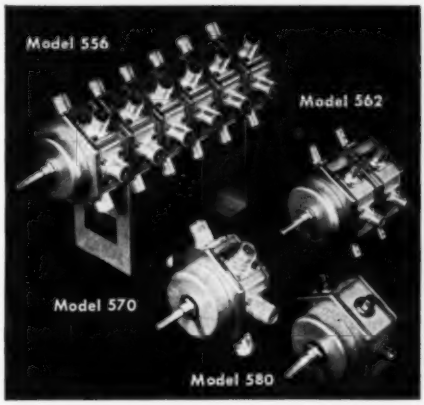


#5 MAIN FRAME VHF RECEIVER

AUDIO-POWER SUPPLY

COAXIAL TYPE SWITCHES
. . . multi-position, single or multiple gang

Now you can switch coaxial line circuits quickly and without error. These handy, inexpensive units are available with "UHF", "BNC", "N" and Phono type connectors for use with either 52 or 75 ohm lines. Phono connector types are specific for Hi-Fi applications. Other types are designed to handle RF Power up to 30 MC, 1 KW input.



Stock items ready for shipment are:

Model 550A—Single gang, single pole, 5 position switch with UHF connectors. Price: $8.25 each.

Model 551A—Single gang, 2 pole, 2 position special purpose switch with UHF connectors. Ideal for switching any device in or out of series connection in coax line circuits. Price: $7.95 each.

Model 560—Single gang, single pole, 5 position switch, same as Model 550A except with BNC type connectors. Price: $11.95 each.

Model 561—Single gang, 2 pole, 2 position special purpose switch, same as Model 551A except with BNC type connectors. Price: $9.95 each.

Model 570—Single gang, single pole, 5 position switch, same as Model 550A except with N type connectors. Price: $13.35 each.

Model 580—Single gang, single pole, 5 position switch, same as Model 550A except with Phono type connectors. Price: $7.35 each.

Multiple gang types, up to 6 gang for single pole—5 position switches, and as required for 2 pole—2 position switches, are made to order with any connector types listed above. Prices on request.

Barker & Williamson, Inc.

Bristol, Pennsylvania, STilwell 8-5581

Foreign Sales—Royal National Corp., 250 West 57th St., New York 19, N.Y.

OTHER B&W EQUIPMENT: Transmitters AM-CW-SSB • Transistorized Power Converters and inverters • Dip Meters • Matchmasters • Frequency Multipliers • Low Pass Filters • T-R Switches • R. F. Filament Chokes • Transmitting R. F. Plate Chokes • Band-Switching Pi-Network Inductors • Cyclometers • Antenna Coaxial Connectors • Baluns • Variable Capacitors • Toroidal Transformers • Fixed and Rotary edgewound Inductors • Plug-in Coils with fixed and variable links • Straight type air wound coils in a variety of dimensions.

biggest problem using this coil was that I could not tell for sure at what frequency it was oscillating. Harmonics from the oscillator leaked into the 1415 kc *if* stage making it difficult to set the injection level on the product detector. A careful check of the frequency by a Frequency Meter indicated that it was too high. Additional padder condenser brought it down to the proper frequency of 239 kc. This cleared up the last of the troubles with the receiver.

The cabinet is a LMB model W1D using a 11" x 17" x 3" chassis. The front panel was painted and striped in the same manner as my 500 watt linear amplifier that was described in a recent issue of 73 Magazine. The chrome trim on the front panel came from the dash of a junked car. The dial is one of those fine Eddystone units made in England. I added internal lighting by installing a pilot light at each end of the dial assembly. The pointer on the dial and the tuning meter are painted a bright red. The cabinet is a light grey, the front panel is dull black and dark grey. The dial is calibrated from 14 mc to 18 mc using the frequency meter. The remainder of the dial scales are geared to this calibration. Typical 432 mc and 1296 mc converters suitable for use with this receiver may be found in the 1963 *Radio Amateur's Handbook*.

. . . WØRQF

"Receiver? Now what would **she** do with a receiver?"

Heliwhip Tuning without Pruning

Frank Mohler W2IAZ
187 Broad Street
Eatontown, New Jersey

1/2"
SOLDER ENDS TO PREVENT UNRAVELING.
SOFT COPPER SHEET 3"x1" WRAPPED INTO CYLINDRICAL SHAPE. PINCH ENDS TO OBTAIN SNUG SLIDING FIT.
SHIELD COVERING FROM RG-8/U CABLE. ACTS LIKE CHINESE FINGER LOCK TO PROVIDE SNUG ADJUSTABLE FIT.

TYPES OF TUNING CYLINDERS
FIGURE 1

After using heliwhips for mobile operation during the past few months. I was able to arrive at a few conclusions you may find interesting. In the first place, the heliwhip is an efficient, high-Q antenna and offers the unique appearance. However, like base-loaded and advantages of short length and unobtrusive center-loaded whip antennas, the heliwhip is frequency conscious and restricts QSY operations to a narrow portion within a band.

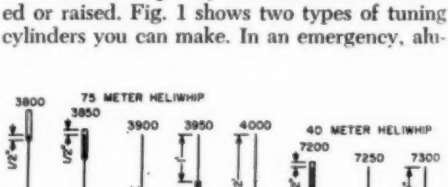
After a series of tests and measurements, I learned that a given heliwhip has a bandwidth that is approximately equal to 1 percent of the antenna's optimum frequency. For example, a heliwhip peaked to 3900 kc has a bandwidth of about 39 kc (.01 x 3900). Satisfactory operation with this heliwhip is therefore limited to the range of frequencies 3880 kc to 3920 kc, or roughly 20 kc either side of the optimum frequency.

The same bandwidth percentage (1%) is applicable to the other bands. For 40-meter operation, a heliwhip pruned to 7250 kc will be useful over the band 7215 kc to 7285 kc. A 20-meter heliwhip cut for 14,250 kc is good over the range 14,180 kc to 14,320 kc. When peaked to 21,300 kc, a 15 meter heliwhip permits satisfactory operation over a range of frequencies 100 kc on either side of the resonant point.

A review of the bandwidth capabilities of each antenna reveals that a heliwhip cut for optimum operation in the middle of the band will provide adequate coverage on all bands except 40 and 75 meters. Unlike the base-loaded and center-loaded whip antennas, the heliwhip has no provisions for altering the operating frequency. After the wires of the heliwhip have been irrevocably cut, or pruned, to a desired frequency, operators accepted the sad fact that QSY operations were severely limited. However, owners of heliwhips need not be shackled to a narrow band of operation. By using the simple tuning technique described in the next paragraph, the operator can peak-tune his heliwhip antenna to any part of the band, including the cw portion at the low end and the MARS frequencies outside the high end.

Heliwhip Tuning System

Heliwhips, as you know, are made by spirally winding the wire on a fibreglass core. Because of this unique construction, heliwhips can be peak-tuned to different parts of the band in less time than it takes to tune a guitar string. All you need is a 3-inch cylinder of copper or aluminum that will fit snugly over the helical windings of the antenna. By sliding this metal cylinder up or down on the heliwhip, the resonant frequency of the antenna is lowered or raised. Fig. 1 shows two types of tuning cylinders you can make. In an emergency, alu-



TUNING POSITIONS
FIGURE 2

new issue just out!

the radio amateur CALLBOOK

Essential QTH information for all radio amateurs and SWL's. Each quarterly issue of the CALLBOOK is completely revised to bring you the most up-to-date information on QTH's.

PLUS THESE EXTRA FEATURES!

- Great Circle Bearings
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P.S. ORDER THESE VALUABLE RADIO AMATEUR GUIDES, TOO!

Radio Amateur DX Guide—62 pages of vital data; 291 Great Circle Bearings for 22 major U.S. cities; Prefix Map, Time Conversion Table, DX Log, plus other features..... $2.00

World Prefix Map—Full color, 29" x 42", shows prefixes on each country . . . DX zones, time zones, cities, cross referenced tables $1.00

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See your favorite dealer today for your latest issue or order direct from the publisher (add 25c for mailing).

minum foil from a pack of cigarettes can be used.

The table in Fig. 2 shows the position of the tuning cylinder for each 50 kc change in the range 3800 to 4000 kc. Similar settings for the 40-meter heliwhip are also given. Present calibration marks on the heliwhip permit rapid positioning of the tuning cylinder when optimum operation on a different part of the band is desired.

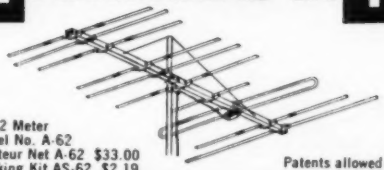
Operating Notes

Newly purchased heliwhips are designed by the manufacturer to resonate at the low-frequency end of the phone band. An unpruned 75-meter heliwhip will, therefore, operate best on 3800 kc. To facilitate QSY operations within a band, I peak-tuned each antenna to the middle of the band. In this way, the amount of deviation required to tune up on either band edge is kept to a minimum.

Heliwhips provide high-Q, above-average radiation efficiency when the antenna is peak-tuned to the desired frequency. However, QSY operations are handicapped by the lack of provision for tuning the antenna to different frequencies. To overcome this advantage, while enjoying the efficiency of these unobtrusive antennas, try the "tuning without pruning" sliding cylinder. Man, it's the most!

. . . W2IAZ

2 ANTENNAS IN 1



6 & 2 Meter
Model No. A-62
Amateur Net A-62 $33.00
Stacking Kit AS-62 $2.19

Patents allowed and pending

The Only Single Feed Line
6 and 2 METER COMBINATION YAGI ANTENNA
another first from **FINCO®**

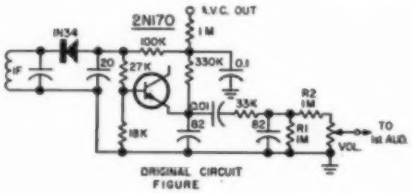
ON 2 METERS
18 Elements
1 — Folded Dipole Plus Special Phasing Stub
1 — 3 Element Colinear Reflector
4 — 3 Element Colinear Directors

ON 6 METERS
Full 4 Elements
1 — Folded Dipole
1 — Reflector
2 — Directors

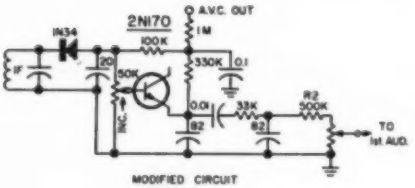
See your FINCO Distributor
or write for Catalog 20-226
THE FINNEY COMPANY
Dept. 20 Bedford, Ohio

Rate of Change Limiter cont.

Shortly after receiving the September 73, I got busy and built the rate-of-change limiter by K5JKX. There were some rather obvious improvements to be made, especially to the load impedance, which I felt you might want to pass along to your readers.



ORIGINAL CIRCUIT
FIGURE



MODIFIED CIRCUIT
FIGURE 2

Refer to Fig. 1. The load on the limiter consists of R_1 in parallel with the series resistance made up of R_2 and the volume control. For a 500K control, this load would be 600K, not 1 megohm. If 3 volts audio appeared at the limiter output, only 1 volt would appear on the 1st audio grid with the volume control wide open; a loss of about 9 db.

As shown in Fig. 2, the fixed load resistor, R1, is omitted. R2 is chosen to give a total resistance of 1 megohm when placed in series with the volume control. In this case, the limiter sees a load of 1 megohm, and 1.5 volts of the 3 volt audio would be impressed on the 1st audio grid; a loss of only 6 db. (The 6 db figure quoted by Kyle must have been for a 1meg control, in which case neither R_1 nor R_2 would have been required.)

A further refinement is the use of a 50K potentiometer in place of the 27K and 18K resistors. This allows the effective bias to be set for optimum noise suppression.

Since adding this unit to my Lafayette HE-30 receiver, I can operate with my 8 foot strip flourescent on!

. . . K5HPT

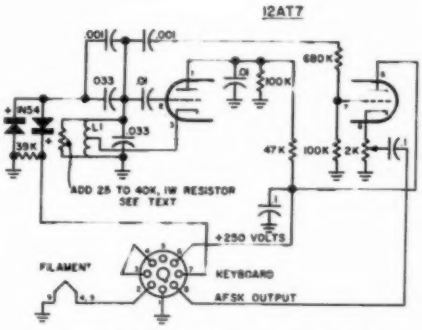
AFSK Oscillator

After completing the Twin City TU AFSK oscillator, the main drawback was that the space tone (2975 cycles) was 50 percent lower in level than the mark tone (2125 cycles). All kinds of equalizing configurations were tried to no avail. Finally a 30K-ohm 1 watt resistor was shunted across the toroid coil L1, to equalize the Q when the IN54's were switched to mark and space tones. Sure enough this method resulted in a considerable improvement between the level of the two tones.

The correct value of resistor depends on how active the circuit is oscillating. Choose a value between 25 and 40K-ohms that will allow the least resistance to be shunted across L1 and still not cause the oscillator to be sluggish by oscillating intermittently.

Now the reports on VHF AFSK are amazing with only a 1 db difference or less between the mark and space tones resulting in a marked improvement with stations reporting solid copy –plus the ability to work more DX. The same approach works equally well with other AFSK circuits.

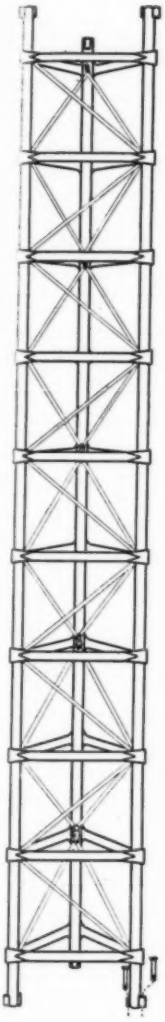
. . . K4GRY



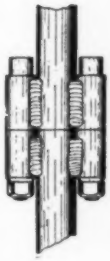
AFSK OSCILLATOR FOR THE TWIN CITY TU

KTV

A SELF-SUPPORTING TOWER UP TO 70 FEET!



The new KTV 1600XX series of communications towers can be installed up to heights of 70 feet withing guying! The 16" wide ten foot long tower sections are joined by double welded-on sleeves on each of the three legs, making one of the strongest tower leg joints ever achieved and avoiding the usual difficulty of the jamming of tower sections. This also avoids the weakness created by holes in the structural members.



The vertical sections are made of 1" diameter 14 gauge steel tubing and the cross ties are 16 gauge tubular steel, wrapped around the vertical tubing every 12" and welded. Any tendency to twist is prevented by the 5/16" continuous XX steel rods which are welded inside the triangular structure. The end product is a tower that is strong enough to support a tribander easily at 50' without guys. This tower can be run as high as 250' with guying every 40' above 65'.

Order your tower direct from this ad or, if you have any special problems or questions, drop us a line.

HY-TRACK

KTV is the only manufacturer of the Hy-Track, an assembly which bolts to your KTV (or other make) tower and allows you to crank your complete rotator and beam up and down the side of the tower in seconds. The Hy-Track consists of a set of rails and a rotator platform and mast bearing which move up and down the rails. On guyed towers it is a simple matter to loosen the guys and lower the beam . . . you don't have to worry about the KTV tower because it is designed to be self-supporting up to 70'. The Hy-Track is particularly handy if you don't want to have to climb up and down your tower to make changes in your antenna, or if you are interested in avoiding the shortage of life that frequently accompanies falling off towers and heart attacks. The complete Hy-Track assembly, all set to go, costs $189.50 to fit on a 30' tower. Add $20 for each extra ten feet of tower. The basic assembly weighs 60 lbs. plus 20 lbs. for each extra ten foot section.

PRICES

Figure that each ten foot section of 1600XX tower costs $40.00 and weighs 50 pounds. The short 42" top section is $20 with a 1¼" or 2" mast hole (specify) and $23 with a 2½" or 3" mast hole. For other size masts write for prices. The rotor mount plate is adjustable and can be placed at any level to match your mast length. It is suitable for the popular rotators such as the Ham-M, CDR, and Hy-Gain. Special plates are available for other rotors. All tower sections are made of 14 gauge galvanized steel.

Base for mounting tower in concrete		$26.00	20 lbs.
Angle roof mount		$26.00	20 lbs.
Three foot roof mount for flat roofs		$32.00	46 lbs.
Wall bracket		$18.50	12 lbs.
42 gauge galvanized screw anchors		$ 7.50	7 lbs.
3/16" aircraft cable 1500 lb. test	ft.	.20	65 lbs. M
Cable clamps		.20	
Tower bolts		.30	
10' 1¼" 16 gauge mast tube		$ 5.00	9 lbs.
10' 1¼" galvanized pipe		$ 9.00	16 lbs.
Erection fixture (jin pole)		$28.00	30 lbs.

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EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	40	40	40	40	40	40	40	20	20	20	20
ARGENTINA	15	20	40	40	40	40	20	15	15	15	15*	15*
AUSTRALIA	15	20	40	40	40	40	40	40	40	40	20	15
CANAL ZONE	20	40	40	40	40	40	20	20	20	15	15	15
ENGLAND	40	40	40	40	40	20	20	20	20	20	20	20
HAWAII	15	20	40	40	40	40	40	40	20	20	20	20
INDIA	40	40	40	40	40	40	20	20	20	20	20	40
JAPAN	20	40	40	40	40	40	40	40	40	40	40	20
MEXICO	20	20	40	40	40	40	40	20	20	20	15	15
PHILIPPINES	20	20	40	40	40	40	40	40	40	40	40	20
PUERTO RICO	20	40	40	40	40	40	20	20	20	20	15	15
SOUTH AFRICA	20	40	40	40	40	20	20	20	15	15	15	20
U.S.S.R.	40	40	40	40	40	40	20	20	20	20	20	40

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	40	40	40	40	40	40	40	20	20	20
ARGENTINA	15	20	20	40	40	40	20	15	15	15	15*	15*
AUSTRALIA	15	15	20	40	40	40	40	40	40	40	20	15
CANAL ZONE	15	20	40	40	40	40	20	15	15	15	15	15*
ENGLAND	40	40	40	40	40	40	20	20	20	20	20	20
HAWAII	15	15	20	40	40	40	40	40	20	20	20	15
INDIA	40	40	40	40	40	40	40	20	20	20	20	20
JAPAN	20	20	40	40	40	40	40	40	40	40	20	20
MEXICO	20	20	40	40	40	40	40	20	20	20	20	20
PHILIPPINES	20	20	40	40	40	40	40	40	40	40	40	20
PUERTO RICO	20	20	40	40	40	40	20	20	15	15	15	15
SOUTH AFRICA	20	40	40	40	40	40	20	20	20	20	15	20
U.S.S.R.	40	40	40	40	40	40	40	20	20	20	20	40

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	40	40	40	40	40	40	40	40	40	40	20
ARGENTINA	15	20	20	40	40	40	40	20	15	15	15	15*
AUSTRALIA	15	15	20	20	40	40	40	40	40	40	20	15
CANAL ZONE	15	20	40	40	40	40	40	20	20	15	15	15
ENGLAND	40	40	40	40	40	40	40	20	20	20	20	40
HAWAII	15	15	20	20	40	40	40	40	20	20	20	15
INDIA	20	20	40	40	40	40	40	40	20	20	20	20
JAPAN	20	20	20	20	40	40	40	40	40	40	20	20
MEXICO	20	20	40	40	40	40	40	20	20	20	20	15
PHILIPPINES	20	20	20	20	40	40	40	40	40	40	40	20
PUERTO RICO	15	20	40	40	40	40	40	20	20	20	15	15
SOUTH AFRICA	20	40	40	40	40	40	40	20	20	20	20	20
U.S.S.R.	40	40	40	40	40	40	40	40	20	20	40	40

***Possible 10 meter openings on Es dates.**

Es means the possibility of a high MUF and/or freak conditions.

PROPAGATION FORECAST
DATE 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
GOOD
FAIR
BAD
Es
= INDICATES PREVALENT CONDITIONS

Propagation Charts

For DX work we will usually find that when working on the proper frequency the best signals are to be found during that portion of the day when the sun is shining on both ends of the circuit. The poorest signals are found just before the sun sets, or rises, on the Western terminal of the circuit. This is the frequency transition period.

During summer, when twilight is prolonged, the effect is least but during the winter months when the twilight period is short the effect can be quite severe.

As we pass through September this effect will become increasingly manifest.

During even quite severe disturbances DX signals can be good during the daylight hours but go bad near the sunset hour often not to return until daylight the next day.

J. H. Nelson

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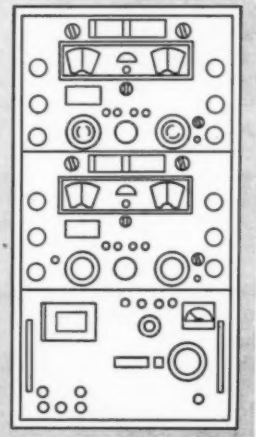

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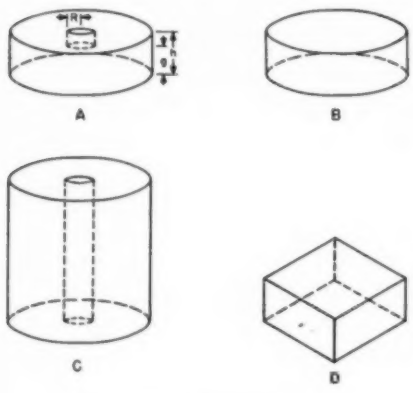
UHF Cavity Design

Jim Kyle K5JKX
1236 N. E. 44th
Oklahoma City 11, Okla

While thousands of published words have been expended on the subject of tank-circuit design for the lower frequencies, we've seen almost nothing in print in the ham magazines concerning design of cavities for UHF use. But with the rapidly growing move to ever higher frequencies, some idea of how to design a cavity is essential for the do-it-yourselfer.

"Why design a cavity?" you may ask, and the question is in order. The first answer is that you almost have to design one when you need it since they are not off-the-shelf items, and published designs (even) are few and far between. On top of that, any published design is almost useless to you unless you are using the exact same circuit and components—since cavity dimensions depend on a whole flock of variables, not just upon frequency alone.

So let's proceed into the only-partially-charted byways of the UHF regions, and take a look at how to design cavities:



TYPES OF CAVITIES
FIGURE 1

A good first step would be to examine just what a cavity is. By definition, a cavity is *any* space fully enclosed by conductive material. The shape of the space is immaterial, but will influence the frequencies of resonance. The cavity will be resonant at every frequency at which any dimension is an integral number of half-wavelenghts—and it follows automatically that every cavity has an infinite number of possible resonant frequencies.

However, this seemingly discouraging fact is of little immediate concern, because for our purposes we are using the cavity either as a filter or as a tank circuit, and in either case we are going to supply energy at a frequency which is at least approximately known. So long as only *one* of the infinite number of possible resonant frequencies is within the area we want to use, we will have no trouble.

Of course, should the cavity also be resonant to a low-order harmonic of our intended frequency, we might have problems. Fortunately, the most practical design types have resonances separated in such a manner that this problem seldom if ever arises.

By our definition of a cavity, it includes all shapes. However, design procedures differ for the different possible shapes. In general, they boil down to two major classes, with some subgroups. One class is that of "right cylindrical cavities," which if you recall high school geometry will be immediately identified as a section of circular pipe; the other is that of "prismatic cavities", which in more everyday terms means a closed box with six flat sides, such as a cube or a covered chassis.

The subclasses of the "right cylindrical" group include the reentrant cavity (the most general type), the pillbox cavity, and the coaxial line. The reentrant consists of a tube closed at each end, with a concentric post inside. A

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"gap" is left between the end of the post and the far wall of the tube. Fig. 1-A shows a perspective drawing of a reentrant cavity.

The pillbox cavity may be thought of as the limiting case of a reentrant, in which the gap has been increased until it extends the full length of the cavity. Similarly, the coaxial line forms the other extreme, in which gap spacing drops to zero and the center "post" is connected to each end plate. Fig. 1-B shows a pillbox cavity, while the coaxial line is sketched in Fig. 1-C.

The prismatic cavity is shown in Fig. 1-D. Though it is easier to build one of these, the design techniques are so involved that we won't go into them here. Frequently, once design of a reentrant cavity is completed, you can transform it into a prismatic cavity of square cross-section without extreme difficulty. This, however, does not always hold true—if you try it after reading this, it's at your own risk.

Having met the four most common types of cavity (even though three are of the same general type, it's more common to speak of them as separate types for reasons which will become apparent as we continue); let's see how they work.

The job of a cavity is to determine frequency, and it does this by virtue of its dimensions. Detailed explanation of just *how* it does this leads us directly into Maxwell's field equations, complete with partial derivatives, so if you're interested we pass you to the references for details. What we're interested in here is the manner in which dimensions determine the frequency.

Most UHF enthusiasts are already familiar with the resonant line section and half-wave repeater. Briefly, a quarter-wave section of coaxial transmission line shorted at one end and open at the other acts like a tank circuit. Similarly, a half-wave section shorted at both ends also acts like a tank. This half-wave section is actually a coax-line cavity; in this case the length of the line is determining the resonant frequency of the cavity.

As we change the coaxial-line cavity to a reentrant type by introducing the gap at one end, and maintain the gap spacing constant, we will find that to hold the same resonant frequency the line must be shortened. As we shorten the line still more, keeping the frequency constant (as well as the gap spacing), we find that the diameter must be increased to maintain resonance.

When we reach the other extreme of the pillbox cavity by this process, in which the length (now called height since it is so small in comparison to some other dimensions) is the same as the gap spacing and the center post disappears, we will find that the resonant frequency is now controlled entirely by the *diameter* of the cavity. Under these conditions, we can make the height almost anything we want within reason and the resonant frequency will remain the same!

Thus we have seen that in the coax-line cavity the frequency is determined by length with diameter making little difference, while in the pillbox it's the diameter that counts and height has little effect. But how about that in-between reentrant that we sort of skipped over?

It's a complex problem, since in the reentrant four variables all work together to determine the resonant frequency. If any three are kept unchanged, the fourth will determine the frequency. But if two are varied at the same time, the frequency *may* just sit still! These variables are the cavity diameter, the post diameter, the gap spacing, and the height (or length).

At this point, let's pause for a moment and see how the characteristics of any tank circuit may be described. The usual specification at low frequencies is by inductance, capacitance, and load resistance (the last is not always specified as such but is inherent in any application). However, the tank can also be specified by resonant frequency, Q, and shunt resistance —a means of specification which is gaining in popularity as more homebrewers acquire grid-dippers. "Tune to resonance at 50 mc" is a not uncommon thing to see on a schematic these days.

In the cavity region, induction and capacitance tend to lose their meanings since they do not relate directly to any dimension. About the only way to specify a cavity is by resonant frequency and Q.

We have seen how certain dimensions control the resonant frequency. How about Q?

The Q (unloaded Q, that is) of a cavity depends primarily upon the rf conductivity of the material from which the cavity is made and upon the frequency of operation. However, it may be severely degraded by unwise choice of dimensions for the cavity.

For instance, we have seen how in the pillbox cavity the frequency is determined entirely by the diameter and that height is almost immaterial. But height of the pillbox can have an important effect on cavity Q.

It's almost obvious that if the height is reduced to zero the Q must also become zero, since the cavity as such ceases to exist. Actually, Q will have its maximum value with an infinitely high cavity—but this is scarcely practi-

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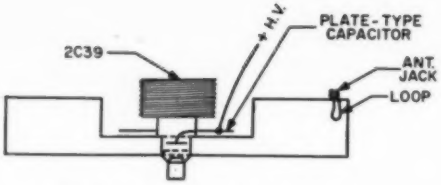

TUBE IN REENTRANT CAVITY
FIGURE 2

cal. It will still have half of this maximum value when the height is reduced to 0.192 wavelength. Therefore, if the height is kept greater than 1/5 wavelength it will do little harm to the Q of the cavity.

As height decreases, so does Q—but not in a straight-line manner. To reduce the Q to one-tenth of its theortical maximum value, the height would have to be reduced to 0.021 wavelength. Since this represents a cavity only about ¾ of an inch high at 300 mc, where the diameter would be about 30 inches, and since a Q of one-tenth maximum would still be in the neighborhood of 1,000, you can see that any reasonable height is satisfactory from a Q standpoint.

Similar conditions prevail in the coax-line cavity. Here, Q will be at its maximum for a certain definite ratio of conductor diameters, which gives a characteristic impedance of 77 ohms. With this ratio fixed, the Q will be maximum when cavity diameter is infinite, and will approach zero as the diameter approaches zero. However, again, within practical limits the diameter (and even the ratio of diameters) is immaterial.

In the reentrant cavity, all the factors which affect frequency also have their effects upon cavity Q. Due to the interactions between the four variables, little can be given concerning the ways in which these effects show up. However, in practice all will be negligible.

All the foregoing, of course, assumes that the interior surface of the cavity possesses good rf conductivity. If you build a cavity out of nichrome, naturally its Q will be way down. But with 5-mil silver plating, Q values will be far greater than you have been used to seeing at the lower frequencies. A Q of 1,000 would be astronomical for a conventional coil—it's considered pretty low for a cavity!

And up to this point our discussion has concerned unloaded cavities. They're nice from a theoretical point of view because nothing from outside the cavity has any effect—but for the same reason they are useless. To make use of a cavity in any way, we must load it in some way, either by coupling it into a transmission line to act as a filter, or by coupling it to the plate of a tube to act as a tank circuit.

Coupling to any cavity may be accomplished in either of two ways: electric coupling, by use of high-impedence capacitive coupling to its electric field, or magnetic coupling, an inherently low-impedence technique for coupling to the magnetic field of the cavity.

Electric coupling is accomplished by either inserting a probe (or miniature antenna) into the cavity at a high-impedence point in the cavity, or by placing an electron tube across the highest-impedence point in the cavity so that its plate is connected to one side of the cavity and its cathode to the other. An example of this latter type of coupling is shown in Fig. 2. The ease of this type of coupling makes the reentrant cavity a natural for tank-circuit use.

Magnetic coupling is accomplished by inserting a loop into the cavity; the usual place is near a corner or across one end. The antenna coupling circuit shown in Fig. 2 is of the magnetic variety, illustrating the difference between magnetic and electric coupling.

Not yet discussed, but very important in actual cavity design, is the effect of lumped capacitance upon the cavity's action. For example, the plate-cathode capacitance of the tube in Fig. 2 is directly across the highest-impedence point in the cavity. To design the cavity rather than just build it, the effect of this added capacitance must be taken into account.

Unfortunately, mathematical design procedure for cavity resonators takes no account of the exact effects of such lumped capacitances except in the special case of the coax-line cavity. In the coax-line, the effect of lumped capacitance is to electrically lengthen the line. The resulting effect is expressed by the formula shown in Fig. 3, which states that the effective line length of the line itself in electrical degrees is equal to the angle whose tangent multiplied

FOR RESONANCE:
$X_c = Z_o \tan L$
Given C and L:

$$f = \frac{0.159}{C \cdot Z_o \cdot \tan L}$$

where f is in Mc if C is in $\mu\mu f$ and Z_o is in ohms

LOADING A COAX CAVITY
FIGURE 3

TABLE I—Thermal Qualities of Some Cavity Materials

Material	Expansion Coefficient PPM/degree F	Frequency Change in cps/mc/degree F
Steel	6	6
Copperclad Steel	7	7
Copper	10	10
Yellow Brass	11	11
Aluminum	13	13

ly the line impedance is equal to the capacitive reactance of the lumped capacitance. Or, in simpler language, the line is tuned to a lower frequency which can be calculated.

Addition of lumped capacitance to the other types of cavity resonators also lowers the resonant frequency, but calculation of the exact amount by which the frequency is lowered is a much more difficult problem. The most practical way for the homebrew ham to take this factor into account is to design the resonator for a frequency approximately double that which he desires, then load the cavity with additional capacitance after tubes are installed until it resonates at the desired point.

This specific factor—lack of knowledge concerning the exact effects of capacitance loading upon the characteristics of a cavity—is one of the biggest drawbacks in cavity design today. It makes successful design of a "ring amplifier" a tedious, cut-and-try process instead of the simple procedure it at first appears to be. Some of the more ambitious UHF men, such as K2TKN, have gone to the lengths of building specialized laboratory test equipment in attempts to learn more about these factors; their results will be interesting and useful.

Before moving on to discuss the actual procedure for design of a cavity, let's spend a couple of minutes looking at some purely mechanical—but still important—factors which influence the frequency stability of the finished cavity.

It's well to remember that the dimensions of the cavity are the major influence upon its resonant frequency—and all materials change dimension under the influence of temperature. Thus you should choose the material for the cavity not only on the basis of its strength, expense, or conductivity—but also on the basis of its thermal coefficient of expansion (how much it changes size when it gets hot).

These coefficients of expansion are listed in Table 1 for the more popular cavity materials, together with the frequency changes in cycles per megacycle per degree F. As temperature rises, the frequency will increase. Note that the old chassis favorite, aluminum, comes in in last place in this listing! And the listing is in

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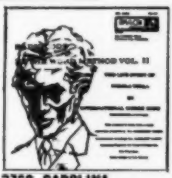

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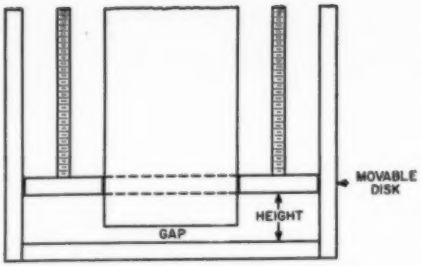


TUNING REENTRANT BY VARYING HEIGHTH
FIGURE 4

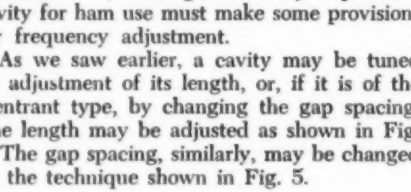
order of desirability, with the most stable materials at the top of the table. Probably the most reasonable compromise would be the use of copper, which combines good plating qualities, good expansion properties, and ease of working.

The resonant frequency of the cavity will also be affected by the humidity—and this you have precious little control over. Taking 60 percent relative humidity as the starting point, an increase of humidity to 100 percent will cause the frequency to decrease by 0.006 percent—a change of 6 kc per megacycle. Decreasing humidity to 20 percent causes frequency to increase about the same amount. Changes of air temperature have similar effects but of much smaller degree.

Since you can't do much about humidity effects, it might seem pointless to mention them. However, they are mentioned just so you will know about them when they show up. They can be compensated for by retuning the cavity at each use.

Speaking of tuning, we have so far made no mention of it, although obviously a practical cavity for ham use must make some provisions for frequency adjustment.

As we saw earlier, a cavity may be tuned by adjustment of its length, or, if it is of the reentrant type, by changing the gap spacing. The length may be adjusted as shown in Fig. 4. The gap spacing, similarly, may be changed by the technique shown in Fig. 5.



TUNING REENTRANT BY VARYING GAP
FIGURE 5

If tuning is done by changing the length frequency will decrease as gap spacing de tuning is by means of changing gap spacing frequency will decrease as gap spacing de creases.

Another method of tuning a cavity, fre quently used in ham construction, is tha shown in Fig. 6. This uses a modified neu tralizing-capacitor plate to change the valu of a lumped capacitance in the cavity, and it effect on a given cavity is difficult to predict As capacitance increases, however, frequenc will decrease.

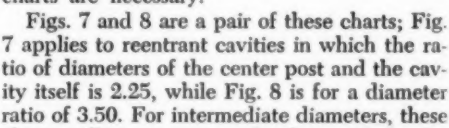
So now, after all the background and theore tical material, we're ready to attack the prol lems of actual cavity design.

Design of a coax-line cavity is simplicity it self; simply divide the wavelength correspond ing to the desired resonant frequency by two multiply by the velocity factor of the line (if you are using a solid coax—otherwise this is irrevelant, since the velocity factor of an air filled line is 1.0), and you have the length. Di ameters can be whatever you require. Remem ber, though, to design for a frequency approx imately twice that at which you intend to oper ate, to allow for loading effects and have room for tuning.

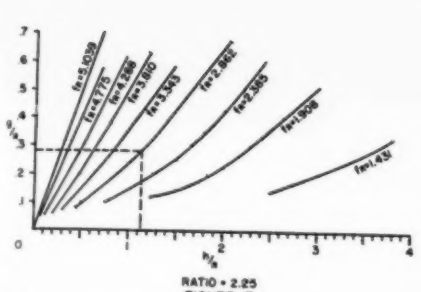
For a pillbox cavity, divide the wavelength corresponding to design frequency by 2.61 to determine the radius of the cavity; diameter will be twice this figure. Height is immaterial so long as it is greater than 0.021 wavelength.

However, both coax-line and pillbox cavities find only limited ham applications. By far the most useful all-around cavity design is the reentrant style—and since its design involves a function of not one but four variables, design charts are necessary.

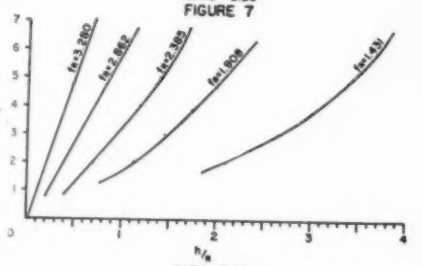
Figs. 7 and 8 are a pair of these charts; Fig. 7 applies to reentrant cavities in which the ratio of diameters of the center post and the cavity itself is 2.25, while Fig. 8 is for a diameter ratio of 3.50. For intermediate diameters, these charts will give a range of values and the desired values will lie within this range.



CAPACITOR TUNING OF CAVITY
FIGURE 6



RATIO = 2.25
FIGURE 7



RATIO = 3.50
FIGURE 8

Frequency is shown in kilomegacycles—this will be true only if all dimensions are measured in centimeters. The conversion from centimeters to inches follows the equation 2.54 centimeters equals one inch.

These charts are somewhat complex and their use is best shown by working out an example. Let's design a cavity to operate at a frequency of 1296 mc and using a cavity diameter of 4¾ inches. A center post diameter of 1¾ inches will result in a diameter ratio of 2.25, so we now turn to Fig. 7.

The small amount of specification we have already done has fixed the values of two of our four variables, leaving only gap spacing and cavity height to determine from the chart. But before we can do this, we must determine which of the frequency lines to use.

Note that gap spacing, cavity height, and frequency are all given in terms of their relationship to center-post *radius* (rather than diameter). Thus, our first step is to convert the center-post diameter of 1.75 inches to a radius in centimeters. Multiplying the inch measurement by 2.54 converts to centimeters, and dividing by two converts diameter to radius. Our figure (calculated by a six-place log table) is 2.2225 cm; we round off at this point to 2.2. Multiplying this by the design frequency in kmc (1.296) gives us 2.8578; using the line marked 2.862 will be plenty close enough for our purposes.

Next step is to note the possible range of values covered by the frequency line chosen;

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in this case gap spacing can range from a g/r of 0.08 to 0.67, with corresponding h/r values from 0.42 to 2.05. Converting these figures to centimeters by multiplying them by r (2.2) we find that gap spacing can range from 0.176 cm (less than 1/10 inch) to 1.474 cm (just over half an inch). With the smaller gap, height will be 0.924 cm (about ⅜ inch) while with the larger one, height will be 4.51 cm (just over 1¾ inches).

From these ranges, we can pick either the gap spacing or the cavity height we prefer, and the other dimension will then be read from the curve. Let's choose a gap spacing of ¼ inch just to illustrate how the process works.

After converting the ¼-inch spacing to centimeters and dividing it by r, we come up with a g/r value of 0.285. We locate this value on the g/r scale by interpolation (dotted line in Fig. 7) and follow over until it intersects the frequency line marked 2.862, then drop vertically to the h/r scale (dotted vertical line) to find the h/r value. In this example, it is 1.11. Multiplying by r, we obtain 2.442 cm as the height of our cavity—or just under one inch.

The final cavity dimensions, in inches, then become a diameter of 4¼, a center-post diameter of 1¾, a gap spacing of ¼ inch, and a cavity height of 0.961 inches. Making the top plate variable as shown in Fig. 4 allows easy variation of cavity height to allow for final tuning of the cavity.

In this example, we chose a frequency and a diameter, and from those determined the rest of the cavity dimensions. But what if we are free to use any diameter we want—how do we pick the most suitable value with these charts?

A good starting point would be to divide the frequency into the values marked on the frequency lines. The results you get will be the range of center post radius values covered by the charts; they will range from a minimum of 0.43 cm for frequency line 1.431 and frequency of 3300 mc to as much as 100 cm (39.4 inches!) for a frequency line of 5.0 and frequency of 50 mc.

Once you pick a suitable center post radius multiply it by either 4.5 for Fig. 7 or 7.0 for Fig. 8 to determine cavity diameter; the choice of which to use is yours, remembering that the larger-diameter cavity tunes to a lower frequency, all other dimensions being equal.

From this point, simply continue as previously described, except that you have already determined the value for r (center post radius) so it need not be recalculated.

If you would like additional curves for other diameter ratios, you can find them on pages 73 through 75 of "Klystrons and Microwave Triodes", a volume of the MIT Radiation Laboratory Series published by McGraw-Hill and available in many libraries. However, you should seldom need them.

We hope that this material is of some help to the would-be UHF experimenter; those looking for more data can find it in the above-mentioned volume, as well as in *Reference Data for Radio Engineers* published by ITT-Kellogg and to a lesser extent in the past three editions of *Radio Handbook*. Both these volumes are available from Radio Bookshop.

Dual Antenna System for Mobile

Frank Mohler W2IAZ
187 Broad Street
Eatontown, New Jersey

A motorist is already familiar with a dual roadway which reduces congestion on highways. Use of the dual antenna system offers similar relief from overcrowded airways for the modern mobileer.

Some Mobiling Problems

Did you ever work mobile and encounter the following frustrating situations? Situation 1—You are in contact with a local station on 75 meters. As you travel away from his station he reports that QRM is beginning to clobber your low-powered signal. His signal is loud and clear in your mobile receiver and you would like to continue the QSO. What can you do? Or take situation 2—You are looking for a local QSO to get information about the unfamiliar area through which you are traveling. You take a look-see over the different bands with your receiver and tune in a local roundtable on the 75 meter band. You would like to get into this net but your antenna is a 15 meter whip and the 75 meter heliwhip is stored inside the car. To change antennas would take about a minute or so but to perform this change requires that you stop the car. In many cases, such as

when driving on the Freeway or other public racetrack, you are unable to stop the car and perform this operation in safety. What can you do? Or take Situation 3 which happens all too often—You are tuned up on 75 meters but the band is so congested that all attempts to raise a contact are fruitless. You then tune the receiver across the other bands and hear the familiar voice loud and clear on the 15 meter band. It's old buddy Jake that you haven't worked "in a long distance." He is telling someone that he is about to QRT and will stand by for any final remarks before pulling the big switch. Band conditions are good and you know from past experience that you can snare good old Jake if only you had the 15 meter antenna on your transmitter. You have only seconds in which to change antennas and tune up on 15 meters but there isn't time for you to find a safe place to stop the car and make the change. What can you do?

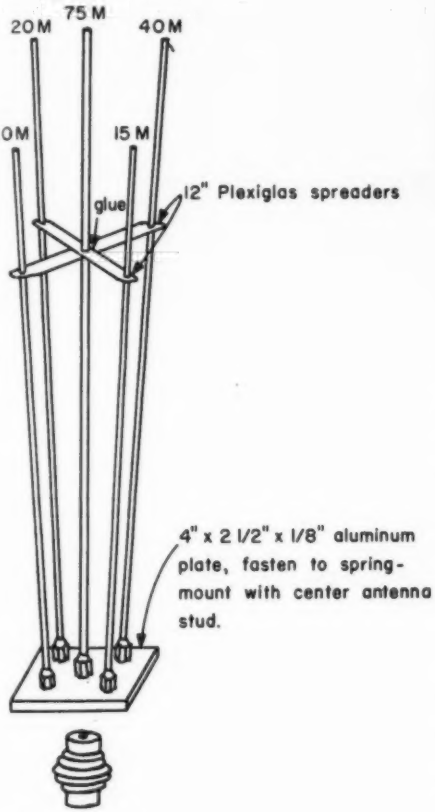


FIGURE 1

A Few Solutions

The obvious solution to such frustrating predicaments is to be prepared with an all-band antenna system that will permit you to bandhop in seconds. What is equally important, but often overlooked, is the ability to change bands without having to stop the car to make antenna adjustments.

One method for accomplishing this is to install an autotune system in which a remote-controlled reversible motor is used to tune a base-loading antenna coil. The disadvantages of cost, complexity, and low radiation efficiency make this method too unapealing to me.

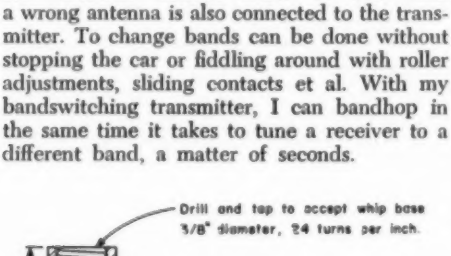
A second method is to install the Umbrella Stand or Porcupine Array shown in Fig. 1. The bristling appearance of this all-band mobile antenna system is so startling that I recommend its use only to those who have exceptionally strong gastric systems. As I say, this method will work if you can (UGH) stand the sight. Technical details are shown in Fig. 1. The aluminum adaptor plate will accommodate sepa-

rate heliwhips for five different bands. Removal of the cented heliwhip allows rapid disassembly for traveling through civilized areas.

As a compromise solution, the mobileer might try the dual antenna system that is relatively uncomplicated, is presentable in appearance, and is guaranteed to double your enjoyment of mobile operation.

Dual Antenna System

The idea is simple enough. Just mount two antennas on the car; one at the front, and one at the rear. Then connect both transmission lines—yes, BOTH of them—to the transmitter. I use a T-junction coaxial fitting on my transmitter to make this connection. In my mobile station, I normally use a 15 meter heliwhip mounted on the front fender of the car and a 75 meter heliwhip mounted on the rear bumper. Purists can install and use an additional selector switch at the transmitter to permit alternate use of either antenna. I learned that such a switch is an unnecessary luxury, for on trying the dual antenna system I found that each antenna performed normally. Apparently, the correct antenna doesn't know or care that a wrong antenna is also connected to the transmitter. To change bands can be done without stopping the car or fiddling around with roller adjustments, sliding contacts et al. With my bandswitching transmitter, I can bandhop in the same time it takes to tune a receiver to a different band, a matter of seconds.


Drill and tap to accept whip base 3/8" diameter, 24 turns per inch.
1/2" Bolt
Shank
Head
1/2"
Drill and tap to accept 1/4" machine screw to fit original antenna base.

ANTENNA BASE ADAPTER
FIGURE 2

Advantages of the Dual Antenna System

Now how does this dual antenna system offer the solution to the situations discussed at the beginning of this article? Take the first situation—The other station is beginning to lose you because of QRM on 75 meters. The solution: Tell him, even if you do have to repeat 5 or 6 times that you will QSY to 21.3 mc but will continue to listen to him on 75 meters. From experience, this method works almost all of the time and allows a satisfactory continuation of the QSO which otherwise would have been unhappily ended.

Situation 2 as well as Situation 3 offers no problem when this dual antenna system is used. Without stopping the car to make antenna adjustments, you merely bandswitch your transmitter to the alternate band. In less time than it takes to say, "Allagazandas Ragtime Bebop" you can be working out on the alternate band and you have a good chance of hooking old buddy Jake before he pulls the big switch.

Installation Tips

Because of the relatively short length of the 15 meter heliwhip, I mounted this antenna on the front fender of my car. I used the same antenna mount which had been used for the broadcast receiver antenna. The particular antenna mount on my car (56 pontiac) was designed to accept a ¼-inch threaded stud. To permit its use with the standard ⅜-inch stud on transmitting mobile antennas, I fabricated an adaptor plug shown in Fig. 2. This adaptor plug was made from the head and shank part of a ½-inch bolt, which was drilled and tapped as shown in Fig. 2. I suppose any ¼ to ⅜-inch adaptor can be purchased and used, but if they are not available in your area, this idea for making it yourself may be helpful.

Because of its short length (approx. 4 feet), the 15-meter heliwhip is mounted directly into the front mount without a spring shock-mount base. The appearance is quite shipshape and attractive. A spring shock-mount base is installed on the rear bumper of the car to accommodate the 75-meter heliwhip (or alternately the 40, 20, and 10 meter whips). The spring base is not necessary for use with the lightweight flexible heliwhips but was installed to permit alternate use of less flexible types when making comparison tests. I use RG-8 coaxial cable to connect both the front-mounted and the rear-mounted antennas to the coaxial T-junction at the transmitter located under the dash panel of my car. Both antennas are fed simultaneously by the transmitter, although only the antenna which is resonant to the transmitter frequency

will act like it is in the system.

Operating Suggestions

When using the dual antenna system in mobile operation, I find that a certain technique is worth practicing to avoid unsatisfactory completion of a QSO. While in contact with another station, I will make it a point to explain that I can switch instantly to an alternate band if deteriorating band conditions cause a serious reduction in signal readability. For example, when working on 75 meters, I generally inform the other station operator that my alternate frequency will be 21.3 mc in the event of serious interruption or interference to my signal. Instantaneous switching to an alternate, less congested, band has enabled me to complete mobile QSO's which otherwise would have been left dangling in midair like ____ you____ beginning ____ ____ 50 percent ____ sput ____ ____ lose ____ sputter ____ 73 ____ phfitt. . . . W21AZ

Eliminating Polar Relay Hash

George Oberto K4GRY

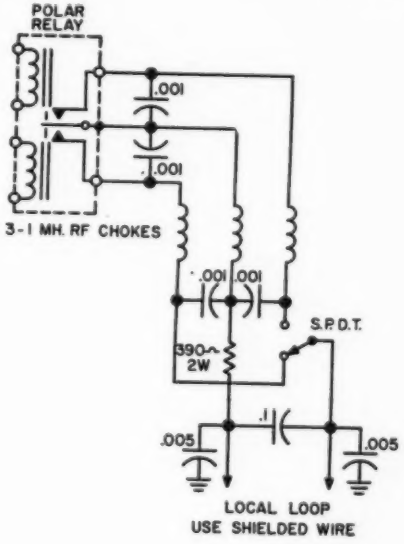
Vacuum tube or transistor type keyers feeding directly to the selector magnet of a teletype printer is often preferred by most radioteletype enthusiasts, because of the elimination of the polar relay with its radiated hash problems. If we can get rid of the troublesome relay hash, a properly adjusted polar relay is preferred, because of the extra range that will enable us to dig down in the QRM for the weaker RTTY signals.

In using several RTTY converters, with and without a polar relay, it was decided to try and eliminate the troublesome hash from the polar relay contacts, keying a 60 ma loop, feeding the selector magnet of a model 15 page printer.

The circuit uses several of the popular methods to adequately suppress the polar relay hash. Four .001 mfd ceramic capacitors are wired, as shown, two across the bottom and two across the top of the three 1 mh rf chokes. At the bottom of the rf chokes the popular hash suppression circuit consisting of a 390-ohm 2 watt resistor and a .1 mfd capacitor is utilized. A .005 mfd ceramic capacitor is wired from each side of the .1 mfd capacitor to ground.

The entire assembly is installed in a small aluminum minibox and all wires including the printer cord are well shielded (using two wire shielded cable) with the printer, converter, and receiver connected to a common ground; preferably a cold water pipe or a ground rod driven deep into the earth. The receiving antenna should use coax cable to feed the antenna. The end result is the elimination of all traces of radiated hash from finding its way into the receiver's antenna system.

. . . K4GRY



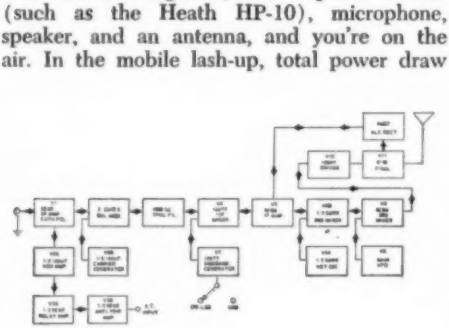
73 Test the Heath HX-20

Robert Buaas K6KGS

Heath Company calls their new HX-20 a MOBILE SSB TRANSMITTER. All this it is, and more. Compactly packaged is a complete filter SSB transmitter/exciter for mobile, portable, or fixed use. Advanced mechanical and electrical design make the HX-20 a real performer. Modern styling and "ease-of-operation" make this unit a natural mobile transmitter. It is the opinion of the author that Heath has come out on top AGAIN.

The HX-20 sports an 11 tube circuit (not to mention the 7 diodes and 2 gas voltage regulators) that emits 100 watts PEP of USB, LSB, and CW. Associated circuits provide VOX, ANTI-TRIP, ALC, receiver muting, and antenna switching. Provision is made to "spot" the VFO either by "talking it on frequency" or by inserting carrier and zero-beating.

The HX-20 was designed to be used with the HR-20 in a mobile installation. Simply connect the two together, add a power source (such as the Heath HP-10), microphone, speaker, and an antenna, and you're on the air. In the mobile lash-up, total power draw on the battery on voice peaks is 150 watts, from a 12 volt dc source. Receiving power is 80 watts. All oscillators in the HX-20 run continuously, accounting for the additional power drain.



BLOCK DIAGRAM

For fixed use, the HX-20 may be used to excite a 1 KW linear amplifier (such as the Heath HA-10) or may be operated "barefoot." The 6146 power amplifier develops up to 50 watts average output on all bands. Hetrodyne circuitry and temperature compensation of the VFO are used to obtain maximum frequency stability and image rejection.

A block diagram of the HX-20 is shown in Fig. 1. As one might imagine, the schematic is very involved, thus it was omitted here. A triple-conversion hetrodyne circuit is used to obtain SSB at the desired output frequency. All oscillators are crystal controlled, with the exception of the VFO, of course.

Audio from a high-impedience microphone is amplified in the pentode section of a 6EA8. The triode section of the same tube acts as a cathode follower to provide the proper match for the crystal filter. A sample of this audio is amplified in ½ a 12AU7, the VOX amp. This VOX audio is rectified and used to control the relay amp, the triode half of a 6EA8. The other half of the 12AU7 is used as a carrier generator for the crystal filter, the frequency being crystal controlled at 4990 kc. Output of this stage is coupled to the Balanced Modulator, two matched germanium diodes. A path for inserting carrier is provided for tune-up and CW operation.

The lower sideband of the DSB suppressed-

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S-38A Rec 24
S-38C Rec 29
S-38E Rec 34
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SX-100 Rec 179
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HQ-110C Rec 134
HQ-120 Rec 69
HQ-129X Rec 99
HQ-140X Rec 125
HQ-145 Rec 149
HQ-145XC Rec 175
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R-9A Rec $ 49
APS-50 Sup 19
TBS-50 Xmtr 29
TBS-50C Xmtr 34
TBS-50D Xmtr 39
T-90 Xmtr 59
80T Xmtr AS-IS 25
Any TBS-50 series Xmtr AS-IS 25
HEATH
Sixer $ 39
AT-1 Xmtr 19
CA-1 Alarm 4
MP-1 12v Sup 29
MR-1 Rec 49
MT-1 Xmtr 49
QF-1 Q-Mult 9
RX-1 Rec 149
TX-1 Xmtr 169
VF-1 VFO 17
VHF-1 Seneca 159
GD-1B Grid Dip 24
AR-3 Rec 29
HG-10 VFO 29
HP-10 DC Sup 29
SB-10 SSB adapter 59
HD-11 Q-Mult 14
DX-20 Xmtr 24
HP-20 AC Sup 29
HR-20 Rec 99
DX-40 Xmtr 39
DX-60 Xmtr 59
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DX-100 B Xmtr 149
O-11 Scope 29
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HE-45 Xcvr 69
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NC-190 Rec 149
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2m Conv 29
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HA-6 Transvertor 249
P-26 AC Sup 69
SX-100 Rec 249
SX-111 Rec 199
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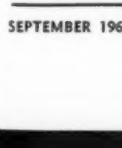

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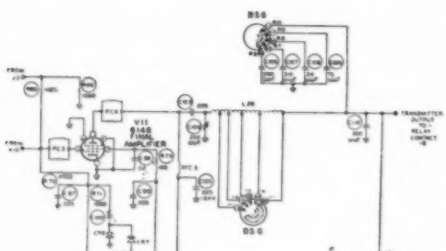
carrier signal obtained in the balanced modulator is suppressed in a crystal lattice type filter. It passes frequencies from 4990.0 to 4992.7 kc approximately. The low-Z output of the filter is connected directly to one grid of a 12AT7 "first-mixer."

USB or LSB may be selected directly. Another 12AT7 is used for two crystal oscillators so that the sum or difference frequencies of the USB signal at 4990 kc and the crystal oscillator selected will produce a 9000 kc USB or LSB signal respectively. Thus, the xtal freqs. are 4010 and 13990 kc. Provision is made for tuning the USB and LSB carrier freqs. to the same frequency. The output of the first-mixer is tuned to 9 mc in a Hi-Q double-tuned *if* transformer.

A single 6CB6 increases the 9 mc SSB signal to a usable level. The plate circuit is again a Hi-Q transformer. ALC voltage is used to bias this stage to keep from driving the final amplifier into the non-linear region. In the CW mode of operation, the "Drive" control on the front panel allows the operator to set the amount of cw output. This feature is an asset in tuning up the rig "on-the-air" without hetrodyne QRM.

Nine mc SSB is coupled to the second-mixer, the pentode section of a 6AW8. The triode section of this tube is used as a xtal controlled hetrodyne oscillator, providing the second mixer with injection voltage. The output of the 6AW8 mixer is tuned 5 mc higher than the output frequency selected by the bandswitch. Hi-Q slug tuned circuits and traps are used. SSB from the second mixer is fed to the third-mixer, a 6CB6.

Injection voltage for the third mixer comes from the VFO, an electron coupled serier tuned Colpitts oscillator. Plate and screen voltages are regulated by an OA2 gas regulator tube. Electrical stability is excellent: the capacitors in the frequency-determining tank have three different temperature co-efficients. Only 3 milliamps are drawn through the 6AU6, contributing more to the electrical and thermal stability.



The difference frequencies found at the plate of the third mixer are selected with Hi-Q slug tuned circuits, connected in the plate circuit by the bandswitch. These tanks are tuned to the output frequency, one for each band. Output of the 6CB6 is amplified in the 12BY driver, which is again resonated to the output frequency in the plate circuit. The third mixer and driver plate tanks are "gang-tuned" to reduce the number of front panel controls and to simplify tune-up. This control is labeled "Driver" on the front panel.

Blocking bias is connected to the control grids of the third mixer and driver stages rendering them inoperative during standby periods. The output freq. is "spotted" by unbiasing these stages. Grid-block keying is used in CW, providing no key clicks or chirp.

The plate of the 12BY7 driver is capacity coupled to the 6146 Final Amplifier. Control grid bias is regulated at -50 v by an OC2 voltage regulator and resistance voltage divider. Screen voltage is regulated at 200 v by a tap on the voltage divider supplying the VFO OA2 voltage regulator. A fixed loaded pi-network is used in the final amp. plate circuit. The input of the pi-net is resonated to the output frequency with a 250 mmfd variable capacitor labeled "Final" on the front panel. The output impedance is fixed, chosen to match a 50 ohm non-reactive load. An rf "sniffer" samples a small amount of the output. This signal is rectified and displayed on the relative output meter on the front panel.

An interesting feature of the HX-20 is the ALC circuit. Fig. 2 shows a schematic diagram of the final amp and the ALC. ALC voltage is applied to the 9 mc *if* amplifier control grid in the form of negative bias. When the final draws no grid current through R71, the 1K grid resistor, no ALC voltage is developed and the *if* amp operates at maximum gain. When grid current starts to flow, a voltage drop appears across the 1K resistor, the waveform of which is that of the input speech peaks. This voltage is coupled by C100, a .1 mfd capacitor, to a voltage doubler circuit, CR1 and CR2. The ALC voltage decreases the gain of the *if* amp., reducing the drive, thus bringing the final back into linear operation. A sample of the rf drive at the final grid is returned to the receiver for spotting the

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VFO. The "sniffer" circuit is also shown in Fig. 2.

Anti-trip audio from the receiver is amplified in the pentode half of a 6EA8 and rectified to provide negative bias to compensate for receiver pick-up in the microphone. This negative anti-trip voltage is applied to grid of the VOX relay amp along with the VOX voltage.

Some hold-up in production must have existed at Heath when the author ordered his HX-20 because it was back-ordered two weeks. The kit was well packed; no damage was found on unpacking. Even the cardboard box survived the 2500 mile trek in one piece. All the components are of highest quality, as in the HR-20. All tube sockets are ceramic. The output coil is wound on a 2" ceramic form. Parasitic suppressors are used in the Driver and Final Amplified stages. All leads at rf ground are well by-passed. Twenty-two heavily plated steel brackets make up the HX-20 chassis and internal shields. When bolted together, these parts make an extremely rugged framework. VFO drive gears are spring loaded to eliminate backlash. This rugged construction and spring loading contribute greatly to the excellent stability of the VFO. Although the HX-20 is well shielded, it is not difficult to build. Heath says that approximately 45 hours of construction time is required. The amount of time required varies with the experience of the builder. This figure represents the time required of a relatively inexperienced constructor. Patience is of the essence in the building of this kit. In places, components are wired 4 and 5 layers thick. A very professional job of wiring can be achieved if the builder carefully studys the instruction manual previous to picking up the screwdriver and pliers.

Upon completion of wiring, the HX-20 was given a thorough resistance check before power was applied. Finding no errors, power was turned on; no smoke resulted. Alignment is straight forward, and no re-peaking was required. A VOM will not work when one is tuning up the hetrodyne oscillator. An 11 meg input VTVM must be used. Even then, grid voltage was found to be a little below specified on 10 meters.

Since the author dislikes the use of RCA phono connectors at RF, BNC type UHF connectors were used in place of the connectors supplied. The phono connectors would, no doubt, work well, but the authors HX-20 and HR-20 are moved from the rack in the mobile regularly, placing undue wear on the coax cables. It was found that straight through operation of the 6AW8 second mixer on 75 meters did not supply enough drive to the 6CB6. Thus, the 2.7K resistor, R38, was changed to 4.7K, 1 watt. This solved the problem.

The specification sheet states that carrier suppression is 50 db while suppression of the unwanted sideband is 55 db. The proof of the pudding was the "on-the-air" test. Excellent reports were received, on both quality and signal strength. Frequency stability is remarkable. The HX-20 was clamped in a paint mixer and allowed 30 minutes to warm up. After warmup, the output frequency was hetrodyned with a 10 meter harmonic of the 100 kc frequency standard. After 15 minutes

of vigorous mixing, the HX-20 had moved only 1500 cps. Someone try this test on a 32S1. No one has volunteered the use of one here, yet!

Other than the stability test, the HX-20 was compared with a KWM-2. The HX-20 lacks the frequency "re-setability" that the KWM-2 possesses. Careful interpolation can bring the HX-20 within 1.5 kc, whereas the M-2 can come within 200 cps. There is only 3 db difference in power output. VOX, ANTI-TRIP, and ALC tied for first. As far as size goes, the KWM-2 is a transceiver and the HX-20 is a transmitter. No valid comparison can be made. Note gents that the HX-20 is just a tad smaller than the 32S1.

For the money, it will be extremely hard to de better than the HX-20. It is the opinion of the author that the HX-20 and HR-20 make one of the best rigs on the air today—with the added consolation that one does not have to sacrifice one of his gold fillings.

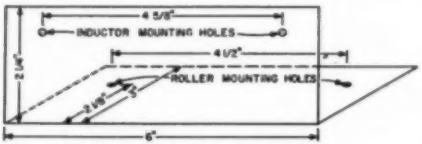
. . . K6KGS

Remotely Controlled Variable Inductor

Ronald Lumachi WB2CQM
73 Bay 26th St.
Brooklyn 14, New York

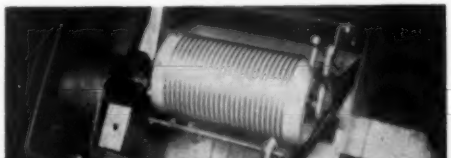
I faced the problem of changing antenna inductance in relation to ground potential. When I decided to become sophisticated and raise my 32' vertical plus coil from 40' (roof-top) to a height of 71'. Although the physical transferral of the antenna to its new position was made without difficulty, when my bridge and dipper were placed on the line, I was shocked to note the resonance change. Since I am somewhat inhibited about climbing to the tops of swaying towers, some remote means of altering inductance was needed. A system controlled from the shack was the answer.

Since I am new to amateur radio I had originally turned to the Command series of transmitters for a first rig. My original purchase was an 80 meter BC-696. The variable inductor (to resonate long wires) had been removed and thrown into the junk box. After meditating for a long period of time, this piece of valuable, equipment was exhumed from the maze of wires, tubes, shoes and other choice bits of equipment that make up the average ham



RIGHT ANGLE FOR VARIABLE INDUCTOR

FIGURE 1



shack. This undistinguished bit of equipment was to provide the solution to this quasi-intricate dilemma. I realized that variable inductance, controlled remotely was feasible and extremely inexpensive.

The parts required are:

1 5" x 7½" x 4" plastic food container & cover
1 female co-ax connector
1 1-5 rpm motor (Barry's Elect. NYC, $1.59)
2 right angle fittings constructed from scrap
  a. 6 x 3 x 2¾"
  b. 3½ x 2 x 1¾"

The right angle supporting the variable inductor is cut and tapped as per Fig. 1.

The small right angle is cut from scrap metal to provide the mounting for the motor. The dimensions are as per Fig. 2. In my case the

(Turn to page 58)

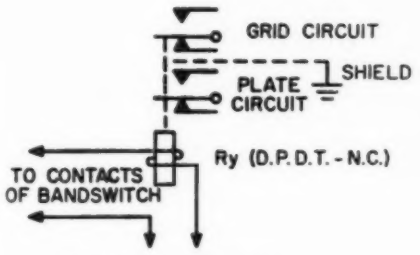
Efficient Bandswitching

In building or designing that new bandswitching transmitter, receiver, converter, signal generator and so forth with one or several bands at a VHF frequency, it is best that the leads be short and direct as possible, and the grid input and plate output wiring properly isolated from each other to obtain maximum circuit efficiency.

It often being the case, it is impossible to get that grid or plate circuit wired into the the bandswitch properly. A simple way to overcome this is to use one or more relays in conjunction with the bandswitch when switching to a VHF band. The relays can be a dpdt, spdt, or what we need for switch contacts, and by mounting the relay close to the grid input and plate output circuits this results into a well performing circuit.

To control the relays the band switch is wired up to energize the relay solenoid when switched to its band position on the bandswitch. Six, 12 and 110 volt ac or dc relays will work okay and be sure that the current drain of the relay solenoid is low to prevent pitting of the bandswitch contacts.

. . . K4GRY



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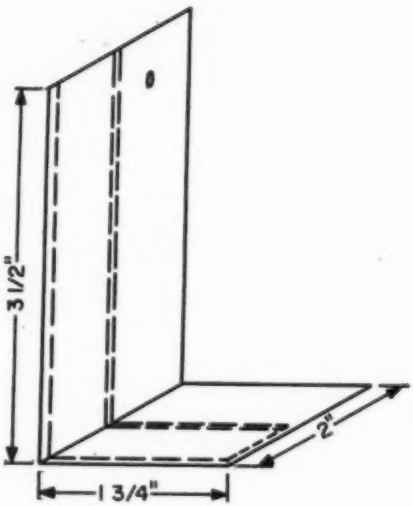

MOTOR MOUNTING BRACKET
FIGURE 2

sheet metal needed to be reinforced by a heavier angle. I felt it was easier to work with this material and later slip heavier gauge metal into position for the extra support. Needless to say, one could construct this support at the outset in a heavier material. The additional brace is portrayed by the dotted line in Fig. 2.

A careful examination of the roller indicated that the thumb wheel originally used to drive the inductor could be removed. This was tapped with a small drill and threaded roughly with a bolt of comparable size. This gear was then placed on the shaft of the motor with a bit of glue judiciously applied to lock this assembly. The motor and gear were then placed on the small right angle and only *one* hole was drilled to accommodate this mechanism. This was done to allow the motor to pivot on a lobed

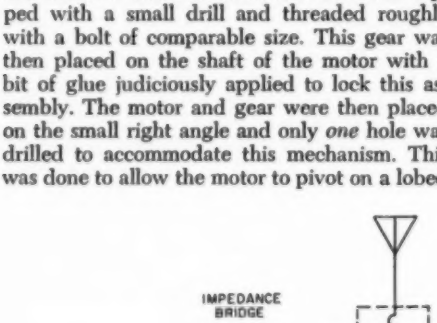

FIGURE 3

plane until a perfect mesh was made between the gears. The nut and bolt were then firmly tightened and to date (after hours of testing) have proved capable of support.

The system was then placed in the plastic food container for protection against the weather, and the bolts inserted through the large right angle, through the roller support, and terminated on the outside of the container. The result is an integrated unit ready for installation on the line, but only after a test run, for it is imperative that the two gears track well. This can be accomplished by bending the motor right angle support ever so slightly in order to accomplish proper working relationships.

The electrical connections are standard as per Fig. 3. The lead from the antenna is connected to one end of the coil (an arm is provided in the original equipment) and the coax fitting is connected to the roller. A length of cable provides the avenue for transmission of power.

With the variable inductor in place on its lofty perch, and protected within its plastic container, one need only plug in a 115 v line (connected to the motor) and watch his bridge. When the meter indicates a null, the plug is pulled from the socket and the radiating system is tuned to the desired frequency.

. . . WB2CQM

Hi-Par Hilltopper

This antenna has been around for quite a while now, but there is a good possibility that some of you VHF'ers may have missed seeing it. The main application for this antenna is for chaps who want to operate from a portable location on six meters. This is a three element Yagi beam, complete with a gamma match for 52 ohm coax, and it folds down into a very small package for carting around in the car or lugging on the back to mountain tops. It weighs only 3¾ pounds.

The Hilltopper is so small that I usually have it packed away in the back of the VW along with a Lafayette HE-45B, just in case any mountains happen to loom up during a trip. The other day, just for the heck of it, Virginia

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and I zipped up to the top of Pack Monadnock and within three minutes I was on the air. Stations well over a hundred miles away were worked with fine reports.

The beam takes less than two minutes to assemble. All of the screws are tightened with wing-nuts, so you don't have to fight with a screw-driver. The elements fold along the boom and the boom comes apart in the middle so that the package goes down to only 40" long, 3½" x 4½" square. The ends of the elements telescope in for folding.

Most rigs are designed to work with 52 ohm coax, so the built in gamma match solves a lot of problems that might be troublesome with the more common beams and their 300 ohm feed which would then have to be fed through a balun to the rig.

The Hilltopper was used exclusively during the June VHF QSO Party with the Clegg Thor and turned in a remarkable performance. 247 stations were contacted in 31 ARRL sections. When you consider that one of the most formidable six meter installations in the country also worked only 31 sections, using a kilowatt and a 64 element beam, the Hilltopper did amazingly well. Costs $11.95 from Hi-Par, Fitchburg, Mass.

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2176.500	2185.625	2194.125	2202.583	2208.313	2212.063	2214.000
2214.563	2223.250	2243.500	2250.000	2265.250	2293.750	2681.000
2695.000	2715.000	2782.000	2855.000	2877.000	2887.000	2894.000
2990.000	2998.000	3000.000	3005.000	3020.000	3035.000	3052.500
3057.500	3143.5000	3154.500	3156.500	3158.500	3161.500	3166.000
3173.000	3181.250	3181.250	3203.500	3207.250	3217.500	3248.875
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1905	1910	1915	1920	1925	1930	1935	1940	1945	1950	1955
1960	1965	1970	1975	1980	1985	1990	2005	2010	2015	2020
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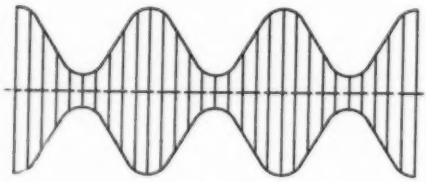
Amplitude Modulation Quiz

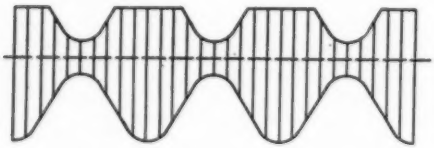
Carl Drumeller W5EHC
5824 N.W. 58th
Oklahoma City 22, Oklahom

1. A sine wave fed into a modulator will cause the modulated RF envelope to resemble the following wave-form:



If the audio wave-form is not symmetrical but looks like this:

The modulated RF envelope then would look like this:



____ True
____ False

2. When a plate-modulated power amplifier is being modulated 100% by a sine wave, the instantaneous plate-to-cathode voltage, as read by an af (not rf) VTVM, will:
____ A. Remain constant if the stage is properly adjusted.
____ B. Vary from 1.414 times the plate supply voltage to 0.707 times the plate supply voltage.
____ C. Vary between zero and twice the plate supply voltage.

3. The instantaneous peak rf power outpu of a plate-modulated rf power amplifie being modulated 100% by a sine wave is
____ A. Same as the average unmodu lated power output.
____ B. Twice the average unmodulate power output.
____ C. Four times the average unmodu lated power output.

4. "Sidebands" normally are present in the radiated output of every radiotelephone transmitter, even when the transmitter is properly adjusted and operated.
____ True
____ False

5. Production of harmonics of the normal rf operating frequency can be reduced by reducing the rf grid excitation to the modulated power amplifier. In view of this correct statement, the question is: "Can this be done to a plate-modulated rf power amplifier without causing its signal to occupy more than its normal share of the frequency spectrum?"
____ Yes
____ No

6. If the audio system of a radiotelephone transmitter is so operated as to cause the production of af harmonics within the audio system, this will cause the transmitter to produce rf harmonics.
____ True
____ False

7. The loss of one tube in a Class B push-pull audio modulator will cause the transmitter's rf envelope (as viewed on an oscilloscope) to appear non-symmetrical.
____ True
____ False

8. The loss of one tube in a Class B push-pull audio modulator will cause a reduction in the audio power produced by the modulator. In view of this true statement, the question is: "Will the total bandwidth of the radiated rf signal be greater than if both tubes were functioning normally?"
____ Yes
____ No

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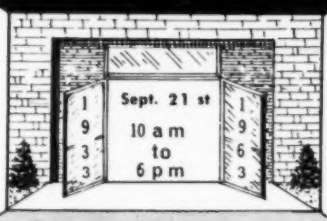

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9. The dc milliammeter in the plate circuit of a plate-modulated rf power amplifier "wiggles" when the transmitter is modulated by a Class B modulator. Check each of the following items that you believe might cause an indication.
   ____ A. Too little rf grid excitation.
   ____ B. Too much rf grid excitation.
   ____ C. "Flat" tube in rf power amplifier (loss of cathode emission).
   ____ D. Over-modulation
   ____ E. Under-modulation.
   ____ F. Poor voltage regulation in the rf power amplifier power supply.

10. A conventional plate-modulated AM transmitter, with no phase modulation or frequency modulation present, sometimes will have more power in one sideband (upper or lower) than in the other sideband.
   ____ True
   ____ False

ANSWERS TO AMPLITUDE MODULATION QUIZ

1. The statement is false. Invariably, the lower half of the envelope of an amplitude-modulated rf wave-form will be a mirror-image of the upper half.
2. C. This is in accord with the explanation customarily given.

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3. C. If, as in the conventional explanation of the process of plate modulation, it is assumed that the instantaneous plate-to-cathode voltage has been doubled at the positive peak of the audio modulating cycle, then the instantaneous plate current also will have been doubled. This, then, will cause the instantaneous peak power to be four times greater than the quiescent power.
4. This statement is, of course, true. Sidebands, an inevitable product of modulation, should never be confused with "splatter," a product of improper modulation.
5. The answer is no. To be plate-modulated, a stage must be operated Class C. This, among other things, means that it must have sufficient grid excitation to operate at full efficiency when the instantaneous plate voltage is double its normal value. All Class C stages deliver their rf power to the plate tank circuit in pulses. This, of course, predisposes toward the production of rf harmonics. This, in a well-designed transmitter, is minimized by the use of a tank circuit of proper Q. To drop the rf grid excitation sufficiently to make an appreciable improvement in the reduction of rf harmonics would require the stage to operate without sufficient rf drive to comply with the prerequisite. Therefore the rf output envelope would be "flattoped," causing the production of spurious frequencies far beyond the normal channel of legitimate sidebands.
6. This statement is false. There is no relationship between af harmonics in the audio systems and rf harmonics in the rf system.
7. This statement is false. As mentioned before, there always is symmetry between the upper and lower halves of the rf envelope from an amplitude-modulated transmitter.
8. The answer is yes. The loss of one tube in a Class B audio stage will cause the audio wave-form to be non-symmetrical, indicating the presence of harmonics. These harmonics will cause the width of sidebands ancillary to the radiated rf signal to be many times their normal width.
9. Choice A is correct. Too little rf drive will not permit the dc plate current to rise fully on the positive crests of the modulating af wave-form. It can, however, go down the full amount. The average value, therefore, will be less than the resting value; so the meter "wiggles" with modulation.
   Choice B is not correct. Too much grid excitation in a pentode or a tetrode tube can cause its total output to drop. This drop, however, would not be noticeable more on modulation peaks than at other times.
   Choice C is correct. If the tube in the modulated stage is lacking in total cathode emission, it will not be able to supply sufficient plate current to permit the plate current to rise fully during positive modulation crests.
   Choice D is correct. If the stage is operating in a husky Class C condition, the plate current can rise to more than twice its quiescent value on the positive modulation crests. It cannot, however, drop beyond zero on the negative modulation crests; therefore it will flicker during over-modulation.
   Choice E is not correct. Under conditions of less than 100% modulation, the plate dc current meter of a plate-modulated Class C rf power amplifier should remain static. Any movement may be taken as an indication of malfunctioning.
   Choice F is correct. This is a design problem, one that seldom is correctly solved in either amateur-built or commercially-built amateur transmitters.
10. This statement is false. An examination of the formula for an amplitude-modulated rf wave (available in any good electronic textbook) will show that the power in the upper sideband always is exactly equal to the power in the lower sideband.

Rotten CW*

**(with sincere apologies to the memory of T.O.M.)*

Alex Tremblay W1GQJ
27 North Avenue
St. Johnsbury, Vermont

With the renewed interest in amateur radio telegraphy and the advent on the market of several automatic telegraph keys, (including mine), it would seem very apropos to review the practices of many of the CW fraternity. Some of these habits are incredible. A lid with a bug at ten words per minute will still be a lid at forty-five per with a fully automatic key as he sends dots at a seventy word rate and dashes at a thirty-five word rate, with six dots for "H". A small minority uphold the finest amateur radio traditions by setting a good example either by their silence, when called for, or by their adherence to near perfection when using the International Morse Code.

Reaching all the way back to a book published in 1917, we come up with the interesting fact that a dash is equal in time duration to one dot, one space and one dot. The space between characters (dots and dashes) is equal in time duration to one dot. The space between letters of the same word is equal in time duration to two dots (a dash). The space between words is equal in time duration to three dots (equal to A, N or S).

Now that we understand the makeup of perfect CW, let us analyze what is actually being sent on the Amateur bands. Here, we may pause and reflect on the plight of the handicapped. Some of this newly developed automatic code sending equipment should prove to be the "equalizer" that will help them in sending CW as well or better than the physically normal. Looking over any busy CW band, The Old Man (bless his memory) certainly would have complained about ROTTEN CW!

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The complaint would be perfectly justified in the light of present day technology which has given us exotic (imagine!!) instruments to help us send perfect code.

Careful listening will turn up some interesting facts:

1. The letter H has three to twelve dots.
2. The letter S has two to five dots.
3. The letter C often comes out N N.
4. The word TEST sounds like NV; always!!
5. The word AND should always be sent: PD.
6. NAME should usually come out: NAG!!
7. The numeral 3 sounds like a Swedish call sign.
8. The first dash sent with a sideswiper should always be extra long and the last dash in any character should alway be cut off a bit short (Sounds like an idiotic pastime, already!)
9. A string of dots from a sideswiper should be either erratic or slurred. (7, 8 and 9 are supposed to make you sound like a real old-timer.)

Heaven forbid that all CW men should send exactly alike. The individuality shown is a good thing, BUT, gentlemen—dashes THREE dashes long; just because you once sent Land Morse for the railroad—wel-l-l . . . Those operators produced by radio club action quite often sound just like their teacher. When they finally get their own "ticket," they will all have the short dots, long dashes and triple spacing just like they heard it at the club.

A few of our so-called speed merchants also have some odd habits which may mislead listeners into thinking that RTTY is not necessary with these fellows around. In order to figure how fast these people are going, we will have to know at what rate per second dots and dashes should be sent in order to accomplish a certain "word per minute" rate. The answer is simply that the number of dashes per second, times five, equals the word per minute rate. An easier way is to look at the sweep second hand of a watch or clock and run dashes for five seconds while counting them. The number of dashes in that period is your "word per minute" rate providing you send at that rate for a full minute. The dots will have to be twice as numerous in the same period. Each word averages five letters.

One night recently, one station, with a near perfect first was pounding a bug at an eight dash per second speed for a "word per minute" rate of forty, and, in each minute managed to send 195 letters. Dividing this total by five gave 39 words per minute. Subtracting an error

and a repeated word, the net words was thirty-eight. Most operators would consider this quite an accomplishment. The other station, using a fully automatic key was doing twelve dashes per second for a word per minute rate of sixty while putting in some extra spacing. The total letters per minute came to 220 instead of the nearly 300 expected. Dividing this total by five gave a result of forty-four for each minute and subtracting four words in error, we came up with a total of only forty words for each minute. Considering all the noise that was being made on the frequency, it was reasonable to expect a lot of words go with it.

A few stations are the practitioners of an unusual habit. They apparently never extend their acquaintance beyond one, and at the most, two, other hams and always on the same band and same frequency. This is such an odd phenomenon in contrast to the familiar "hail and farewell" of a lot of operators, that it was decided to "read the mail." These two birds were only doing a rough twenty-five per, but they could have been sending in Chocktaw for all that was gained by listening. Their sending was so erratic that only by picking them up for a little while during several evenings was it finally possible to make out their call signs. Errors were made in nearly every word and about every third word was split in two and sent as part of the next word, presumably because the sender had to stop and figure how to spell it. The speed varied between extra long dashes and bursts of dots with short and long spacing. Evidently, these two understood only each other as they were never heard working any other station. Here was a horrible example of "rotten CW" at its worst. But, it had its good side in displaying for all to hear the liberties that can be enjoyed so long as they do not infringe on the liberties of others. Such "rotten" operating would undoubtly call for the FCC to decide that in view of the fact that its monitoring facilities could not understand what was being sent, it MUST be in code or cipher in violation of section 12.105 of the Amateur Radio Regulations. These people could then be rehabilitated and soon become outstanding operators at thirteen per in the International Morse Code.

While we are on the subject of the FCC, mention should be made of section 12.133 that has to do with purity and stability of emissions. Many hams have not heard of this, or if they have, the part that they particularly noticed is the one that says: "For the purposes of this section a spurious radiation is *any* radiation from a transmitter which is *outside* the frequency band of emission normal for the type of transmission employed, etc." To them, this must mean that any type of carrier with thumps, clicks, youps, musical saw effects, rattling marbles from bouncing relays, scratching from dirty contacts, backwaves forty kilocycles removed from carrier due to parasitics, etc., is OK so long as these "bonuses" remain within the boundaries of the band being used. One can only wonder if these lids will ever realize just how much noise they are making over and above that amount needed for reliable communication.

Back in the thirties, a real op felt definitely undressed unless he wore, while on the air, the latest model Dynatron frequency-meter-monitor. It must be that the monitor habit perished during WW2 as witness even some real oldtimers who go by the click in their "cans," asking "Hw duz mi sig snd to u om?" Apparently many never knew or have forgotten that a monitor was originally (and still is) a device with tuned circuits which picked up your signal OFF the air and let you know what it really sounded like. That small standby five tube receiver which has been collecting dust can now come into its own. With a very short antenna attached and usually with no antenna whatsoever, it becomes an excellent tuned CW monitor. Sliding off one can a bit, its speaker will let you know how your own rig is doing.

There is little doubt that a sidetone generator helps in sending better code, especially in conjunction with a fully automatic key. (This is so much fun that sometimes the spacing between words is left out.) The statement is made that the sidetone proves by its tape-like sound that good code is being sent. Sure! Sure, the sidetone sounds perfect but what does the actual transmitted signal sound like? "Soam. hw duz mi sig snd to u?"—"Your characters are perfectly formed, your spacing is out of (indeed) this world BUT you've got a backwave that sounds like the guy slamming the car door on a TV commercial."—Wonder how much of that showed up in the speaker of his sidetone generator. A real Radio Frequency Monitor, tuned or untuned, will not only help you send better code, but will also tell you what a lid you are until you clean up your signal. This last may be the main reason for the lack of monitoring facilities at those stations where the need is greatest.

Maximum utility can be realized by keying in one of the low power stages; preferably the oscillator or oscillator/first buffer. Automatic or fixed bias or a clamp tube become a "must" on the following stages, but the extra effort is well worthwhile considering the flexibility obtained. This brings up the question from many

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hams who wonder why they get a "ee-youp" report when keying the oscillator. Many of them run a full gallon and they complain that their lights blink in time with the keying. Here is visible evidence that there is so much voltage drop on the ac side of the power supplies that not enough dc is supplied to the VR tubes to give them anything to regulate. As a consequence, the oscillator "ee-youps"! These boys need to know a lot about adequate wiring.

Differentius Keyitis is the prodigious name of an affliction borne by one who can be heard most any time adjusting (he claims) his keying characteristics. He also, must be without a monitor because he is always in doubt as to the quality of his signal. One of these has a voltage regulation problem plus a bouncing relay contact. It has often been hinted that he sounds like a musical saw with the "beat" like loose marbles in a paper bag. The musical ear must be lacking because the signal quality never improves. The real contemptible cad though, is the habitual vfo swisher who can never be identified except during a contest.

The fully automatics come in for their share of criticism as they adjust their monsters by making endless strings of dots and dashes on the Ham bands while performing these adjustments. The trick is to achieve perfection in the generation of pulses which eventually become dots and dashes. This search for the ultimate does set an example of some sort, but, it should be remembered that we are using this medium not for extreme accuracy for a shot around the moon, but for normal conversation and traffic handling.

This points up several facts absorbed during thirty years of hamming, plus fifteen years previously spent in various experiments. This included (while still in grammer school) the building and operating of a Model "T" Spark rig which used to put old KDKA, WGY etc., off the air locally until an alert constabulary feretted us out ! ! !

FACT 1. A poor note can not only be tolerated but actually enjoyed if from an old friend who has not been heard in a long time. He will be glad to know what his signal sounds like so he can apply corrective measures.

2. Good CW is extremely enjoyable if there is a very slight variation in character lengths, spacing, etc., indicating that a human is manipulating the key. This becomes even more interesting if the operator actually has something to say besides commenting on: the wx, band condx and rig hr is a blankit rng 15Z? ? ? 1H7 . . . 157 watts to a ---
3. Perfect code from a machine is an enduring joy to copy if the receiving end also consists of a machine.
4. Abbreviating the characters on your new automatic so as to sound fully automated will not get you too many ragchews. Try sounding like people again. You will be pleasantly surprised at the results.
5. While the technical prowess of a 'phone operator does not depend on the "DB's over S9" his receiver indicates; when using a key, all the way from the "hand pump" to the most exotic automatic, your CW is *YOU!*

Capt. John Sury W5JSN
139 Nebraska Rd.
Dyess AFB, Texas

Monitor Scope

Have you been thinking about building a monitor scope? This may be the project just for you. Not a whole lot of effort or pocket funds are needed. It sure is nice to monitor your own signal when transmitting as well as helping your fellow hams with their signal. The monitor will not take up much space in your shack because it only measures 5" high by 5" wide by 9½" deep. It could keep you from getting a notice from an "OO."

On transmissions the scope can monitor signals from 80 thru 2 meters. A choke of approximately 1 mh is employed in the input to the crt when transmitting on SSB on the 40, 20 and 15 meter bands and a plug in tuned circuit on 80, 40, 10, 6 and 2 meters. Hams who only work 15 and 20 do not need the tuned circuit. Using a Heath Seneca 6 and 2 a desirable wave shape was observed when modulating normally, but when hitting it hard the peaks were cut off as a result of over modulation. A beautiful trapezoid was observed on SSB. In receive a series of trapezoids were observer on SSB and a series of envelopes on AM. When using a plate modulated transmitter the modulation may be fed to the horizontal and the rf to the vertical. This has not been attempted by the author because he does not own a plate modulated transmitter.

The horizontal sweep generator is a sawtooth wave shape which is variable between 15 and 50 cps. A 30 cps sweep produces a clean trapezoid, envelope or carrier.

Let's get with the building by starting with the chassis. You can purchase a ready made 5 x 9½ x 2" aluminum chassis at your neighborhood electronics store. Drill and cut out all holes as indicated in the chassis layout. It sure can save you a lot of trouble because the author had quite a time trying to locate everything on this small chassis. Obtain some panel

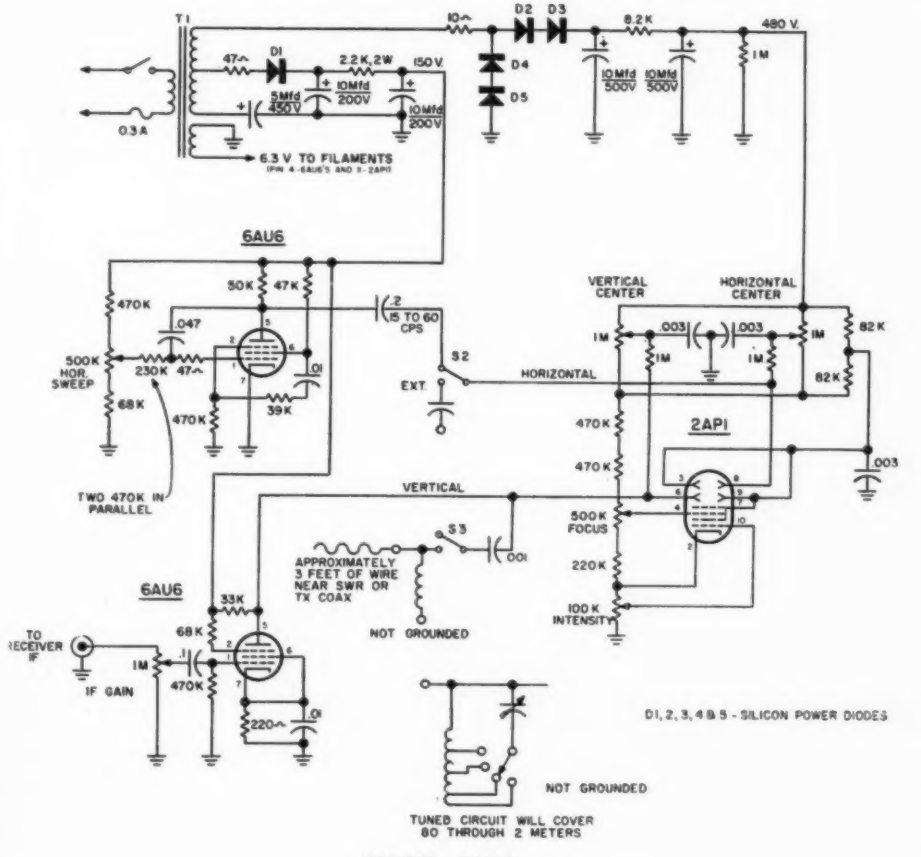
material, 1/16 to ⅛ inch thick aluminum, and cut out all holes as indicated. Lay aside the front and rear panels and install transformer, sockets and terminal strips. A bag of 25 assorted terminal strips may be purchased at an electronic supply house for less than a half of a dollar. In one of these bags you can find the ones just to fit your needs.

Power Supply

This is a low voltage supply as scopes go. A Knight transformer furnishers 125v each side of center tap at 25 ma and 6.3 volts at 1 amp. Even though the current for all tubes total 1.2 amp for filament, the scope has been left on for hours without ill effects or overheating. A voltage doubler is taken off one end of the secondary to give approximately 480v to the crt circuit while the low voltage is obtained from

the center tap. The crt has more than enough brightness and response. Bargain basement silicon power diodes are used for the power supply.

The CRT circuit is just the old standard circuit used on many scopes. A 2AP1 tube or equivalent is used. The 2AP1's were readily available at one time on the surplus market.



MONITOR SCOPE
FIGURE 1

Maybe you were fortunate to get hold of one.

Horizontal Sweep Generator

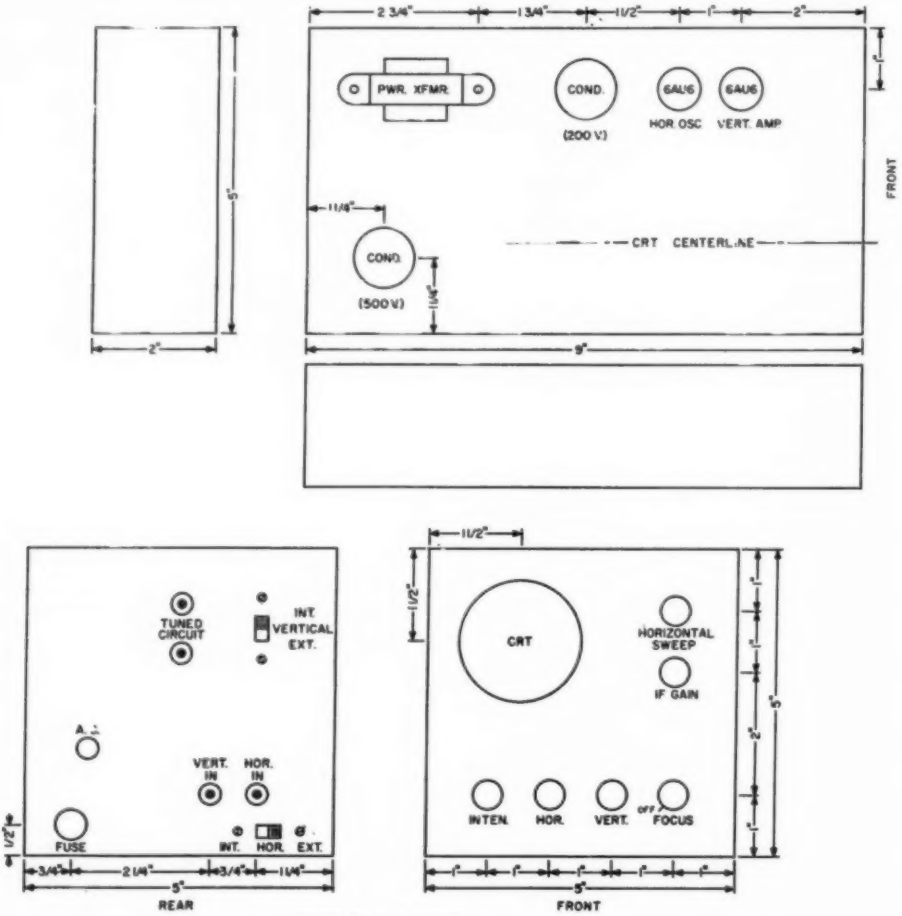
A 6AU6 pentode is employed in this circuit. The frequency is variable between 15 and 50 cps. It has an output of 16 volts which is ample enough to fill the 2AP1. To change frequency range increase or decrease C5. There is no critical wiring, just follow the schematic.

Vertical Amplifier

This circuit also uses a 6AU6 tube. The low current of the tube allows the builder to stay within limits of the power supply. The receiver signal is taken from the plate of the last *if* stage and coupled with a 25 to 100 uuf capacitor. The value does not seem to be critical. This should be a very simple modification to the receiver. The author used a Drake 2A receiver and there was more than enough vertical deflection from the last *if* tube.

Not much more can be said about the monitor scope. It is straight forward with surprising results. The author would like to thank W5SZN, Pete, of Dyess AFB and W5WNK, Smitty, of Sweetwater, Texas, for the donation of a 2AP1 tube and shield. It is possible that the project would not have been attempted if it were not for these two gentlemen. Good luck in your construction of the monitor scope. See you on the bands.

. . . W5JSN



SUGGESTED LAYOUT
FIGURE 2

We Goofed! AND THEN *You Goofed!*

YES we were frank to admit our mistakes in July 73. So we tried to make it up to you and those of you who missed in July had another chance in August. See our full page "GOOF UP" ads in both issues for details!

HOWEVER there is still lots of goodies left and we are even lowering the "BROOM" on some of them. We ask you to simply compare these prices with those of any other ham supplier. Even the cheap and dirty ones can't match these.

WE have the "BIG BROOM" out now for sure and are going for a "CLEAN SWEEP" this time. All, used gear is fully reconditioned and guaranteed 100%. The new gear is new and (confidentially) so are the demonstrators. We know these prices look too low but frankly we just want to sell out and start over.

OF COURSE these prices are for cash and no trade but man what bargains they are!!!!

—73—
Stan Burghardt WØBJV

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Elmac A-54H Mobile Transmitter	39.00
Elmac PSA500 AC Supply	15.00
Globe 755A VFO	25.00
Globe AT-3 Antenna Tuner	5.00
Gonset G-66 & G-77 Mobile pkg.	179.00
Gonset G66B 12 vdc supply	$99.00
Gonset GSB-101 KW Linear	199.00
Hallicrafters HT-37 Transmitter	349.00
Hallicrafters S85 Receiver	69.00
Hallicrafters SX-99 Receiver	79.00
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Hallicrafters SX-71 Receiver	89.00
Hallicrafters S-53A Receiver	39.00
Hallicrafters R-46B spkr.	6.00
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Johnson Invader 200 Transmitter	399.00
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Gonset GR211 Receiver	76.98	39.00
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Hallicrafters SX-111 Receiver	279.95	179.00
Hallicrafters S-119 Receiver	49.95	29.00
Hallicrafters C-119 Receiver Kit	39.95	24.00
Hallicrafters SX-117 Receiver	389.00	275.00
Hallicrafters HT-40 Transmitter	109.95	79.00
Hallicrafters SX-140K Receiver Kit	114.95	69.00
Hammarlund HX-50	449.50	299.00
Hunter Bandit 2000A Linear	575.00	449.00
Loudenboomer KW Linear with power supply	438.00	338.00

See our ad in the June issue of 73 for complete price information and pictures of the Transceiver Hit Parade. Be sure to send for our "Transceiver Packet" which gives full information on the leading brands. And, if you really want to make yourself drool, send for our New Equipment Catalog and our revised monthly Used Gear Bulletin.

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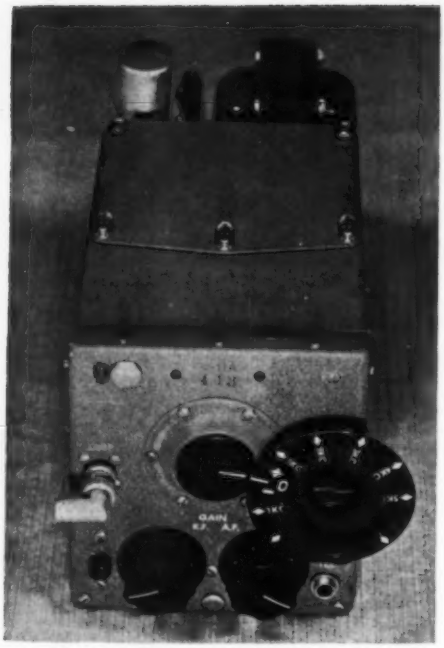

The completed Q5-er conversion.

The Q-5er Reborn

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photos by Morgan S. Gassman, Jr.

A late entry to the famous Command Set line-up is the Aircraft Radio Corporation Type 12 equipment. This is a commercial, light aircraft radio set consisting of a number of individual components that can be arranged to meet navigational, VHF and UHF requirements.

Certain of these postwar production, navigation and VHW radio components were adopted by the military services for light aircraft use. It should be noted that, while the equipment is commonly known as the ARC-12, this is a commercial designation and not the military nomenclature. Although not treated in this article, one grouping of this equipment provides two-way UHF communications. This equipment has been designated as the AN/ARC-60.

Since some of the items are entering the surplus market, they are worthy of amateur attention. The R-510/ARC and the R-511/ARC are likely to be available to the amateur in fair quantity. The VHF equipment is now available in small quantities but the light aircraft market will probably absorb most of the supply.

The ARC-12 equipment is beautifully constructed, using loctal tubes and circuitry which is improved over the BC-435–R-23/ARC prototypes. Changes required to adapt this unit to amateur use will be mentioned later. Physical construction is very similar to the earlier Command Set receivers. The rear chassis connector has been eliminated and all connectors appear on the front panel. No dial scale or dial drive is included on this series of receivers, although the conventional worm drive is provided for the tuning capacitor. Two antenna inputs are supplied. A low impedance loop input is terminated on a BNC coaxial fitting and the long wire antenna input is connected to a front panel binding post. An internal relay switches between the two inputs. The photographs show construction details of the unmodified R-511/ARC receiver.

Aside from the limitations imposed by the lack of a bfo circuit, any of the standard Q5-er modifications are applicable to the receiver and good results may be expected. Conversion of these receivers follows the same pattern as for the more familiar Command Set receivers. A power supply must be constructed for operation from the 115 volt line and the dynamotor mounting plate provides a suitable chassis. Incidentally, the dynamotor mounting dimensions and connections are identical to those of the AN/ARC-5 dynamotor. The power connectors are removed from the front panel, audio and rf

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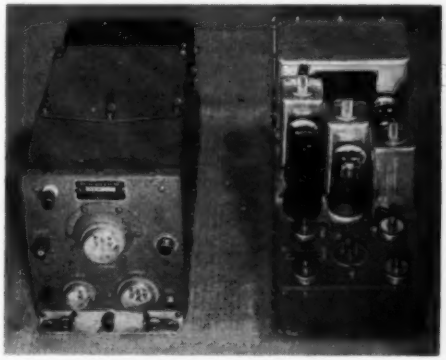
main controls are installed and a tuning knob and dial scale are provided.

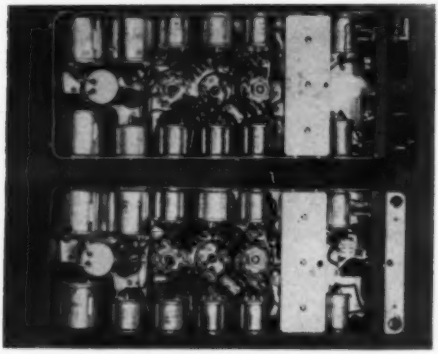
The ac power supply is constructed on the former dynamotor mounting plate and is installed in the same manner as the dynamotor. Construction of the power supply is greatly simplified and circuit changes minimized by use of a power transformer specifically designed for such applications. This transformer is available from Fair Radio Sales Company, 2133 Elida Road, Lima, Ohio. The transformer carries the part number 619 and sells for $3.95.

Remove the dynamotor from the plate, leaving the connector in place. The mounting centers of the transformer specified enabled it to be mounted using existing holes. Carefully drill out the rivets securing the retaining clips at one end of the plate and insert ½", 4-40 machine screws from the under side of the plate. Make a pile up of washers to the same shape and size as the defunct shoulder rivets and place over the screws. Solder 6" insulated leads to each contact of the ex-dynamotor connector and dress toward the other end of the plate. Place the transformer over the screws and secure one side, using a flat washer, lock washer and nut on each screw. Enlarge the two holes falling under the other two transformer mounting slots to accept #8 screws and dress the transformer leads toward the empty end of the plate. Insert ¾" 8-32 machine screws in these holes, install ¼" spacers between the plate and the transformer, and secure, using lock washers and nuts.

The balance of the power supply components are mounted on a 1¾" x 2⅜" aluminum plate. This sub-chassis is mounted on ¾" metal posts, using 3 existing holes enlarged to pass 6-32 machine screws. For the want of a better small connector, a miniature crystal socket is mounted on this plate to permit connection of the ac line switch leads. The 6 x 4 heater is operated from the 5 volt winding of the transformer and no ill effects have been noted as a result of the reduced voltage. The 100 ohm surge resistor, which is listed as a 2 watt unit is shown as a 10 watt wire wound resistor in the photograph. After components are mounted and clearances checked, the assembly may be wired as a standard full wave supply. The photographs show the details and no difficulty should be experienced. This power supply is, of course, equally applicable to either the SCR-274-N or the AN/ARC-5 receivers.



The R-511/ARC receiver before conversion.



The converted receiver is above, the unmodified unit below.

The actual modification of the receiver is next on the agenda. Remove the screws holding the bottom plate and the outer cover of the receiver. Remove the two front tubes and loosen the front *if* can to permit removal of the tuning capacitor shield. Set the covers and mounting hardware aside for future use. Remove the screws and ground post which secure the mounting bracket to the bottom of the front panel. Discard the angle bracket and the ground post, reinstalling the screws.

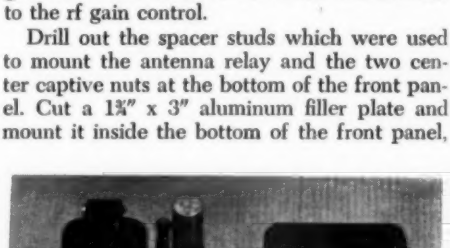
Clip the blue lead connected to the antenna binding post and fish it through the chassis. Remove and discard the binding post, filling the hole with a snap plug. Unsolder the blue lead, along with C-601 and R-601, from the ceramic insulator next to the antenna trimmer. Clip the other ends of these components from the lug on the trimmer capacitor and discard C-601 and R-601. Unsolder from the relay contact the gray lead which runs to the antenna connector, J-601 and connect this lead to the vacant terminal of the ceramic insulator. Remove the second gray lead which runs between a relay contact and pin 5 of L-601A, the antenna coil. Connect a 50 mmfd mica capacitor between pin 5 of L-601A and the insulator to which J-601 is terminated and solder this connection.

Remove and discard the two blue leads which run between the antenna trimmer and a relay contact and between pin 6 of L-610A and a relay contact. Remove the ceramic capacitor C-602, connected between pins 1 and 6 of L-601A and strap these two pins with a length of bare wire. This completes the antenna input circuit changes. The tuning capacitor cover may now be replaced, the *if* can be tightened down and the tubes inserted.

The next steps remove the front panel power connectors and the now unused antenna relay. Minor wiring changes are made to connect the heater and plate circuits directly to the dynamotor connector. Remove the metal extrusion which mounts J-606 to the center of the front panel. Clip all leads connected to J-606 and work them through the chassis clearance hole. Remove J-606 from the extrusion, discard the connector and mount the extrusion to the front panel, using the original hardware. Pull the two red leads free to where they terminate on C-634 and pin 1 of T-60 . Clip these leads, discarding them, and connect a jumper between the terminals of C-633 and C-633B. This step connects the receiver B+ circuits directly to the dynamotor receptacle.

Clip, from pin B of J-602, the black lead which connects to the negative terminal of C-608 and solder this lead to the ground lug of the antenna trimmer. Clip, from the terminals of J-604, the black and brown leads formerly connected to J-606, the black lead which runs to pin C and the brown lead which runs to pin A of J-603. Remove and discard the white lead which runs between pin D of J-603 and one terminal of the filament choke, L-612. Remove one of the white leads from the other terminal of the choke and solder it to the vacated terminal. This removes the filament circuit from the front panel connectors and connects the low inductance choke in the filament circuit of the receiver. Clip the two green leads from pin E of J-603 and dress them aside for future connection to the rf gain control. This frees all wiring from J-602, J-603 and the antenna relay except for the leads which interconnect these components. Remove these parts and discard as a unit. All wiring in the receiver should be terminated except for the two green and one black leads which will connect to the rf gain control.

Drill out the spacer studs which were used to mount the antenna relay and the two center captive nuts at the bottom of the front panel. Cut a 1¾" x 3" aluminum filler plate and mount it inside the bottom of the front panel,



The ac power supply constructed on the original dynamotor plate is shown along with the dynamotor.

using machine screws through existing panel holes. Drill a ¾" hole in the center of the mounting hole for J-602 and a second ¾" hole the same distance in from the panel side and bottom in the J-603 mounting hole. Mount a 50,000 ohm, 2 watt control in the left hand hole and a 2 megohm, audio taper control with switch in the right hand hole. Ground one side of the 50K pot and connect the center tap to the ungrounded terminal of C-608, a 3 mfd capacitor. Remove the resistor (R625, 2 meg) and capacitor (C-636, 350 mmfd) connected to pin 5 of the 12A6. Connect a .005 mfd capacitor between the junction of a 150K resistor and 100 mmfd capacitor from which C-636 was just removed and one side of the 2 meg pot. Ground the other side of the pot and connect the center terminal to pin 5 of the 12A6. Use a defunct crystal holder as the power supply connector for the ac switch leads.

The above work completes the basic modification of the receiver. All that remains is the installation of a suitable dial, control knobs and decals. The tuning knob which fits the splined capacitor drive shaft is identical to that required for the older Command Sets and it has always been in short supply. Fair Radio Sales Company of Lima, Ohio stocks these knobs and the price of $1.00, while high, is in line with the scarcity of the item. The type of dial or dial scale required will depend on the proposed application of the receiver.

In the conventional Q5-er application, the highly selective Command Set receiver is coupled to the last *if* stage of the less selective normal station receiver. The Q5-er is tuned to the center of the station receiver *if* bandpass and tuning accomplished in the usual fashion. In this mode of operation, an uncalibrated knob is all that is required. Alternatively, the normal receiver may be set roughly to the desired frequency and tuning accomplished by sweeping the Q5-er across the *if* bandpass of the normal receiver. In this instance, the Q5-er is required to tune only a few kilocycles. Since one revolution of the Command Set capacitor drive shaft tunes the receiver approximately 13 kc in the vicinity of 450 kc, a scale may be fitted to the tuning knob and directly calibrated in kilocycles above and below the center frequency of the normal receiver *if* bandpass.

The latter method is used in the converted receiver shown in the photographs. The spinner disk of a standard Command Set knob is removed by drilling out the peened over brass shaft and soldering on a 1" extension made from a hollow, brass standoff post. A 2 ¾" diameter dial plate is removed from a standard knob with scale assembly and given a coat of

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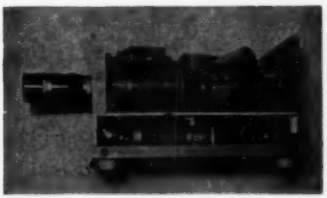

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black lacquer, reassembled, mounted on the new shaft and the unit installed, using the original locking nut. A 1¼" snap hole plug is given a coat of black lacquer and installed in the now vacant J-606 connector hole. An index line is marked on the hole plug, as shown in the photograph, and calibration is accomplished as described later. Knobs are now installed on the audio and rf gain controls. The 1¼" skirts of the knobs shown cover the former connector holes nicely. This completes the conversion and the unit is now ready for test and calibration.

Install the new power supply in the same manner as the original dynamotor and plug in the connector which terminates the ac switch leads. Connect ac power, plug in a pair of phones and advance the audio and rf gain controls. The tubes should light and, after a few seconds, background hiss should be heard in the phones. Connect an antenna and tune across the band. Aircraft range and ship stations should be heard with good volume. Unscrew the caps from the *if* transformers and pull the fiber rods out as far as they will come without forcing. This reduces the coupling of the windings, reducing the bandwidth substantially. Stations should still be heard, at a bit less volume but with greatly improved selectivity. If all checks out OK, install the top cover and the bottom plate and the job is finished.

To connect the Q5-er to the receiver, strip the outer jacket and shield from one end of a length of RG-58/U cable and wrap a couple of turns of the insulated center conductor around the plate lead of the last *if* stage of the station receiver. Install a BNC plug on the other end of the coax and connect to the antenna receptacle of the Q5-er receiver. Couple a signal generator or, better still, a frequency meter into the normal receiver and center the signal in the *if* bandpass by tuning for maximum signal. Tune in the *if* signal on the Q5-er and scribe the "0" calibration point on the tuning knob Offset the signal generator 5 kc above and 5 kc below this frequency and, without tuning the normal receiver, tune the Q5-er for maximum output and scribe both points on the tuning knob scale. Divide the dial scale between "0" and the 5 kc points into five equal sections and mark the individual kilocycle calibration points. Commercial decals may now be applied and a very practical dial results.

Other refinements which may be added and which will enhance the utility of the converted receiver include a bfo circuit, avc disable switch and a self-contained speaker. The latter subject is treated in detail in the article, "Command Set Speakers" which was published in the January, 1962 issue of 73*Magazine*. Many articles have been published on the Command Set receivers and much of this material is directly applicable to the ARC-12 equipment. The references given barely scratch the surface. A comprehensive bibliography of all surplus conversion articles published since the war is now available from 73 *Magazine*.

While the ARC-12 equipment will never be as plentiful as the older Command Sets, the utility is as great. The up-dated circuitry, better wiring and improved components make them more desirable and worth the premium price they will command.

. . . W4WKM

Aircraft Radio Corporation Type 12 Equipment Components

R-507/ARC, R-19 (14 v): VHF, AM receiver, 118 to 148 mc, continuous tuning; 14 vdc power requirement with self-contained dynamotor. Modern 9 tube superheterodyne circuit with 2 rf and 3 if stages, agc, noise limiter and 360 mw audio output into 300 ohms. Sensitivity is better than 2 microvolts for 10 mw output. Selectivity is 175 kc at 60 db down. Unit is very similar to Command Set receivers in appearance except no dial scale is provided and all connectors terminate on the front panel. Rf gain control is external to the set and no audio gain control is provided.

R-508/ARC, R-19 (28 v): Identical to R-507/ARC except power requirement is 28 vdc.

R-509/ARC, R-15 (28 v): Identical to R-507/ARC except power requirement is 28 vdc and frequency coverage is 108 to 135 mc.

R-510/ARC, R-11A (14 v): Lf-mf, AM receiver, 190 to 550 kc, continuous tuning; 14 vdc power requirement with self-contained dynamotor. Receiver uses octal and loctal tubes and features 1 rf and 2 if stages, agc, noise limiter with 800 mw output into 300 ohm load. Sensitivity is better than 2 microvolts for 10 mw audio output. Selectivity is better than 35 db down at 3 kc off resonance and 60 db down at 5 kc off resonance. Unit is very similar to the BC-453 Q5-er except that no dial scale is provided and all connectors terminate on the front panel. No bfo or audio gain control is provided and rf gain control is external.

R-511/ARC, R-11A (28 v): Identical to R-510/ARC except power requirement is 28 vdc.

T-363/ARC, T-13 (28 v): VHF, AM transmitter; 5 crystal controlled frequencies in any 2 mc segment of the 132 to 148 mc band. Range may be lowered to 125 to 132 mc by the use of a special capacity plate. Power is supplied by the dynamotor of the companion receiver through a front panel connector. Transmitter uses 4 6AQ5 or 5763 tubes for a power output of 2 watts into a 50 ohm load. Panel size and construction is similar to the receivers of this series. The case is shortened by the width of the dynamotor which is not used in the intended application.

T-364/ARC, T-13 (14 v): Identical to the T-363/ARC except relay and heater circuits are wired for 14 vdc operation.

T-336/ARC, T-11 (28 v): Identical to the T-363/ARC except frequency coverage is 116 to 132 mc and relay and heater circuits are wired for 14 vdc operation.

T-366/ARC, T-11 (28 v): Identical to the T-363/ARC except frequency coverage is 116 to 132 mc.

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A Double-Conversion Receiver for $30!, WØMYU, CQ, February 1949

New Life for the Q5-er, Jordan, QST, February 1951

Turnable-I.F. Receiver Using the BC-453, W2PPL, QST, September 1959

A Poor Man's Q-Multiplier, W1ICP, QST, March 1960

The BC-453 as a Tunable I.F. in a Multi-Band Receiver, W2PPL, QST, February 1961

Save that Mil

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While the home station usually enjoys almost unlimited current available for gear, mobileers operate comparatively high power with definitely limited power sources. Obviously, any savings that can be effected, no matter how small, will benefit in increased battery and generator life and can easily make the difference between a start and no start.

Various cars differ in their electrical set-up so no exact procedures or recommendations can be given; but your own system should be studied carefully and advantage taken of every little current saver you can find. For instance, if the car is so wired that the front parking lights remain on with the headlights, a separate or different switch can be installed to cut them off when the headlights are on. A savings of 3 or 4 amps can often be effected this way. Instrument and dash lights also need checking. If they can only be dimmer, or are turned off by increasing dimmer control resistance, another switch can be installed to isolate them when not needed. Another few mils saved. If the parking and tail lights are of overly high wattage, they can be changed for lower wattage bulbs (consistent with State regulations and safety, of course) and the same applies to direction indicators and stop lights.

One point to keep in mind, though, if you change the wattage of your flashing turn signals; the flashing unit itself is designed to work with a given load and its rate may be affected by a drop in load. Don't add a resistor to bring it back up—change the flasher unit itself for one designed for the wattage you intend using. And—do you really need all the dial lights on your rig at all times? Would one bulb do where two are now? A separate switch, perhaps? There could be a few extra mils there, you know.

How about the general condition of the electrical system? Most of us take great pains to insure the battery, regulator and generator are all up to snuff and that there are no fuse-blowing shorts; but what about the rest of the wiring system? The entire car should be checked and every current-consuming device given close scrutiny. (Yes, even those wires you have to crawl under the car to find!) Deteriorated insulation on wires, high resistance grounds, bad connections and high resistance shorts can all consume many valuable amps without visible effect—and they all add to the total current drain and leave just that much less available where it's needed.

Arm yourself with a sensitive low-range VOM and check resistance to ground at each device; it should be zero. Any reading here will indicate valuable current being used to heat lamp sockets and connections. Check voltage drop by measuring first at the battery terminals and then at each device (with the device turned on, of course); more than a few tenths of a volt, while acceptable on the normal car, is just too much to waste with a mobile rig. And you may be surprised to find as much as 2 or even 3 volts difference. If you do, it indicates that new and larger wires or switches are in order.

Assume nothing and take nothing for granted until you have personally checked it. That flashy, bechromed light unit can often hide poor workmanship, poor connections and high resistance shorts. And need anything be said about the effects of moisture and corrosion? Generous blobs of anti-corrosion grease (petroleum jelly in a pinch) in the right places can make a world of difference.

There is no short-cut method and you cannot assume that just because the car is new and expensive everything is in apple pie order. A few greasy hours spent with VOM, screwdriver, and pliers will pay dividends in peace of mind, more reliable starting, better overall efficiency and—bonus of all bonuses—a possible "S" unit jump on the other fellow's receiver with those few saved mils applied to your plate!

. . . K1JWU

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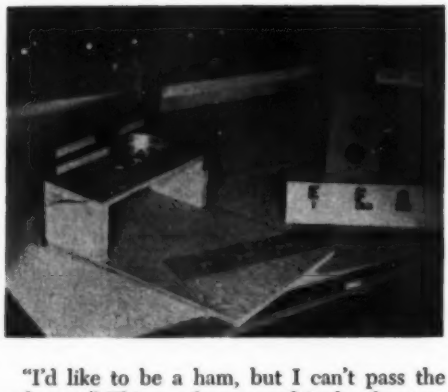

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Learning code by the dot-dash memory method is slow and tedious. Code Master lets you hear the exact keyed musical tone and shows you visually what the character is you are hearing; no di and dah to remember; hence a direct conversion from code to character.

Drag your portable record player out of the closet and measure the depth (top of the turn table to bottom of case in playing position). This is a key dimension to start construction. Fill this dimension in on the sketch.

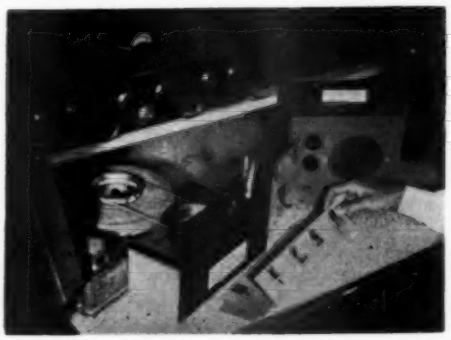
Search the trash box for a couple of screw-on jar lids (instant cofffiee or peanut butter lids work fine) approximately 3½" ri. x ⅝" deep. Drill a ¼" diameter hole in the center of each. Cut a piece of coarse sandpaper to diameter of one lid and cement it to the outside bottom (sand side out) of one lid. Place this lid over the center spindle of the turntable and secure with a tight fitting rubber grommet This forms the drive pulley for your code masteh.

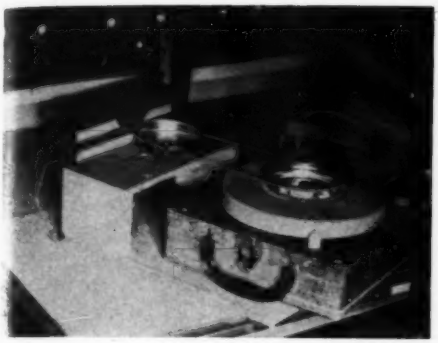
Refer to the sketch and cut a base, spacer blocks (2) and a bearing support from ¾" plywood. Cut a piece of ¼" thick masonite for the front panel to size as shown. Bore a 1" diameter hole for the window in which the coded character will appear.

Drill a ⅜" diameter hole thru the 4" x 10" piece of plywood as shown. Note this hole is offset 1" from the hole in the front panel. Sand the edges of all parts smooth and nail together

Dig into the junk box for a ¼" shaft panel bearing or the threaded bushing from a discarded potentiometer. Cut two pieces of insulated hook-up wire (20 or 24 gage) about 2 feet long. Strip the insulation back 1½" on one and twist it securely under the head of the panel bearing for a good electrical connection. Insert the shank of the bushing thru the ⅜" diameter hole and secure with a nut on the underside. The other end of the wire connects to one side of the audio oscillator key circuit.

Cement a piece of aluminum foil (the bottom of a TV dinner tray is better) 5" long,





centered in the area below (back side) the window in the front panel. Use a paper clip to secure the end of the second wire to the foil plate. This wire goes to the opposite side of the audio oscillator key circuit.

The second lid forms the keying switch for the code master. Punch two small holes ½" apart at the lip edge of the lid. Insert a piece of light gage music wire thru the holes leaving 2½" protruding to the left (see sketch). Solder the wire in place for a good mechanical and electrical connection.

Next, to mount the keying switch. Install a ¼" x 1½" long hex head bolt from the bottom side of the panel bearing; secure it with a nut on the top side. Do not tighten the nut as the bolt must turn freely in the bearing.

Install the lid with the wire projecting to the left. Secure with a lock washer and nut. Check again to make sure the bolt turns freely in the bearing. This completes the mechanical construction of your code master.

Place the record player in position on the mounting base and note the distance between the lid drive wheels. Daisy chain some light rubber bands together to form a drive belt.

Turn on the record player to see if the contact wheel is operating freely.

The code keying stencils are cut from light cardboard. The author found that two for a nickle manila file folders worked perfectly. They are stiff andslick enough to give good wear. Cut the folder into strips 2½" wide x 11⅜" long. Keep the cut edges square. Divide the length of the strip into four equal sections

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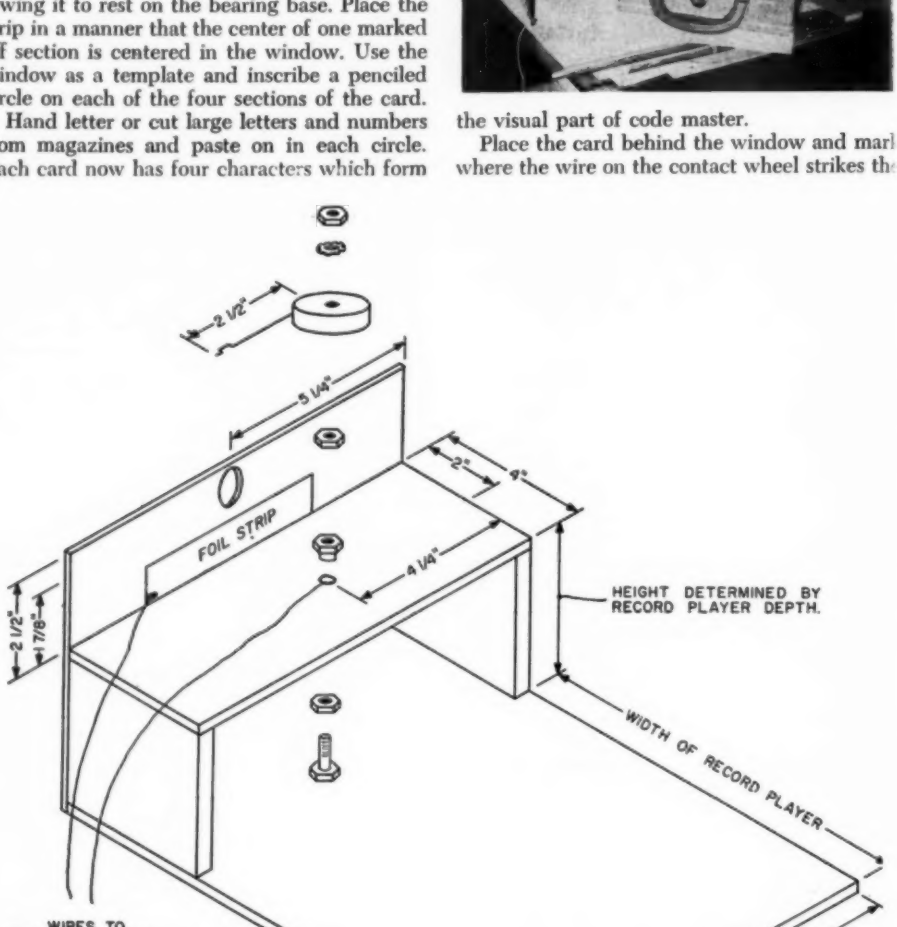
with a light pencil line. Hold the strip behind the 1" diameter window in the front panel, allowing it to rest on the bearing base. Place the strip in a manner that the center of one marked off section is centered in the window. Use the window as a template and inscribe a penciled circle on each of the four sections of the card.

Hand letter or cut large letters and numbers from magazines and paste on in each circle. Each card now has four characters which form the visual part of code master.

Place the card behind the window and mark where the wire on the contact wheel strikes the



card. This is where the audio code stencil must be cut under each letter.

Cut the cardboard away ¼" wide for dots and spaces ¾" wide for dashes. Make the openings ½" long. Note that the contact wheel moves in a clockwise motion so the code stencil must be cut backwards, i. e. "A" is normally . —; it should appear — . on the stencil.

Place a stencil in the code master, holding it in place with a spring clip clothes pin. Turn on the audio oscillator and record player. Sit back and listen to the firm fist Code Master sends you. Associate the character in the window with a tone you hear. In a few days you'll copy code with perfection. The record player speed changer allows you to copy as fast as you like. 33 1/3 RPM equals 6 words per minute; 45 RPM equals 10 words per minute and 78 RPM equals 15 words per minute.

Good luck! We'll be looking for your CW on the ham bands.

. . . K6OKX

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Small power diodes are sometimes an unsuspected source of radio frequency interference.

A small broadcast/FM set was plagued with bad RFI—birdies and spurious rough signals. It was being operated within a mile of a 5 kw broadcast station. It was operated from a bridge of silicon power rectifiers. A .01 disc cap paralleled with each of the four rectifiers cleaned up the RFI.

The local broadcast station was being heard in the ham shack on every one of its harmonics. The trouble was traced to a bridge of silicon rectifiers feeding the antenna rotator. Again a .01 bypass across each of the rectifiers did the job.

A stubborn case of TVI was traced to nonlinear rectification of the transmitter's normally clean signal in a bridge of 24 volt silicon rectifiers operating a T-R relay. The .01 bypass cured it.

It is apparent that all power silicon rectifiers should be bypassed for rf if they are likely to be subjected to a strong rf field. It is easy for these rectifiers to be driven into the nonlinear portion of their characteristics and act as frequency multipliers. Rf voltage picked up on the power lines can easily get to these rectifiers if they are not properly isolated and cause RFI that may be very confusing.

. . . W6JAT

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12 Volt Conversion of the Communicator II

Charles Green W31KH
17 Little Lane
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It was the same old story; after having spent considerable time building and buying equipment for the car, I had to trade the car in. Then came more time in converting the six volt equipment over to twelve volts.

I have always enjoyed two meter mobile with my Gonset Communicator II, but since it was built for 117 vac and 6 vdc, mobile operation was limited to the length of a long ac line cord.

The Communicator II is built with three chassis, a receiver, transmitter and power supply. The power supply chassis is supplied in either six or 12 volt dc versions. (Both with 117 vac also). The receiver and transmitter chassis are wired in a series parallel filament hookup, allowing either six or twelve volt operation by changing terminal strip jumpers.

The main problem in converting the Communicator II to twelve volts was the power supply chassis. A new power transformer, vibrator and rectifier tubes would be needed.

This conversion was not as simple as could be desired, but having no other choice, I decided to go ahead with it anyway.

A commercial equivalent of the original power transformer is the Merit P-2858. This transformer fitted the physical measurements and its electrical ratings are close enough to be utilized. Also, it would fit into the original transformer's mounting holes.

The original transformer was then removed and the Merit P-2858 was then installed. The original vibrator was replaced by a 12 volt

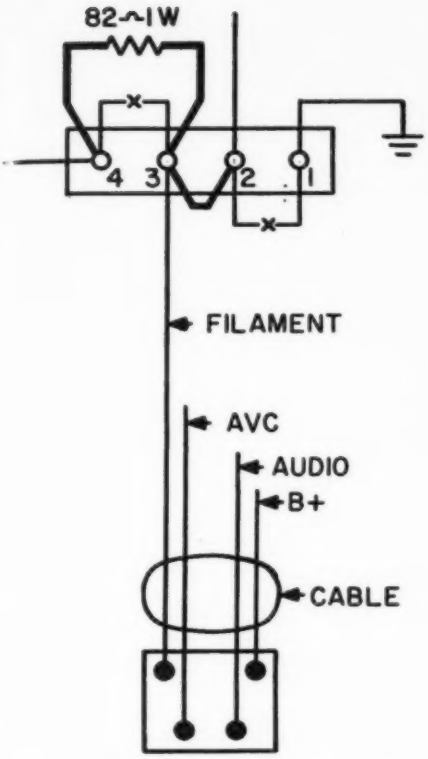

FIGURE 1

type and the 6 x 4's were replaced by 12 x 4's. This did not involve any rewiring.

It was found that the B+ output voltage was higher than that required by the Communicator II, so a filter choke from the junk box, and a resistor in parallel with it (L1, R1) was added to bring the output B+ voltage to the required 300 volts. Any other type of filter choke, with the right resistor in parallel can be used as well.

L1 is mounted on top of the chassis in front of the rectifier tubes and R1 is mounted under the power supply chassis by a long machine screw.

The filament jumper connections on the receiver chassis are changed as in Fig. 1. The 82 ohm resistor is added, as directed by the instruction manual, to balance the filament string for 12 volt operation. The heavy lines indicate additions and the x-x-x lines indicate removals of wiring.

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Fig. 2 indicates the jumper connections to the transmitter chassis. This schematic shows how the filament string is changed from 6 to 12 volt operation.

This conversion has been used by both myself and on K3BBE's Communicator II with good results in both mobile and ac line operation. The only thing that has caused some concern is that the filament circuit requires approximately 2.5 amps while the transformer is rated at 2 amps. But this has not affected operation in any way and the transformer does not seem to be running hot.

Now I'm all set for mobile operation indefinitely, unless the new cars switch over to 2 volt wiring.

. . . W31KI

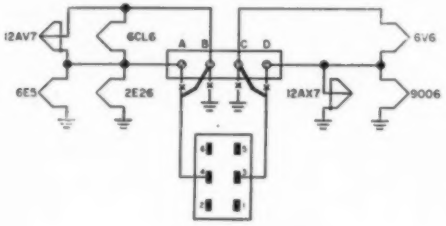


FIGURE 2

Parts List

T1—Power transformer, 12 vdc, 117 vac primaries. 3[illegible] vdc 100 ma hv secondary. 12 vac 2 amp secondary. Merit P-2858

VIB.—12 vdc vibrator. RADIART S-4, Base diag. A. [illegible] equiv.

L1—12 henry, 30 ma, 450 ohm, filter choke. UTC-R-15 [illegible] equiv.

R1—650 ohms, 10 watt, wirewound

12X4 rectifier tube—(2 ea.)

82 ohm, 1 watt, carbon resistor

Note—Any combination value of L1 and R1 that will reduce the output B+ voltage to 300 volts can be used (see text).

73 Tests

Now that Tapetone (Telco) has switched to commercial gear there has been a void in the high quality ham VHF gear department. Thus we were particularly interested when a new company turned up with converters and preamplifiers for the six and two meter bands and made haste to obtain a sample and check it out.

The unit selected was a two meter nuvistor converter. The unit is so low priced ($34.25) that we didn't expect a lot. When the converter arrived we looked it over carefully and were quite surprised at the amount of effort and design that had obviously been put into it. The layout was first rate and by any VHF standards and the construction beautiful. The low price no doubt dictated the economical painted grey finish and the rubber stamped panel markings, but we're after performance, not beauty.

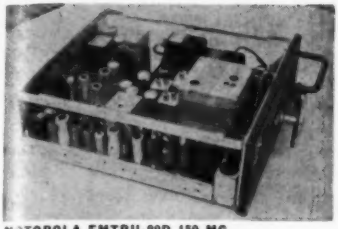
And performance we got. I had been using my old 417A Tapetone converter as a standard and was shaken to find that all was not well. Theoretically the nuvistor job should be able to come close to the Tapetone, but shouldn't be able to actually beat it. It did, and by a wide margin. Hmmm. Back to the lab to see what happened to the Tapetone.

The Amplidyne converter comes tuned for optimum performance on the lower half of the band, where the activity is. Should you desire to use it in the upper reaches you can easily retune it.

Amplidyne has a small matching power supply available ($9.75), complete with power plug. Since I like to change converters around now and then, I sort of wish that they'd used the same power plug as all the others. Amplidyne is to be congratulated on turning out a nice little converter at an exceptionally reasonable price.

Alco Power Supply

Every now and then a need arises for a low voltage power supply to run a transistor radio or converter. We needed such a gadget and decided on trying the $19.95 unit sold by Also. This transistorized variable voltage supply provides from 0-20 volts (read on built-in meter) at either 20 ma or 200 ma (also read on meter). This supply also can be useful in test work where you need a small positive or negative voltage (bias, avc, etc.) and in charging small batteries. Darned handy.



MOTOROLA FMTRU-80D 150 MC
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This unit has a 30 watt transmitter using 2-2E26 tubes. Dynamotor power supply. Receivers are double conversion super het. Receiver uses vibrator power supply. Shipping Wt. 46 lbs.
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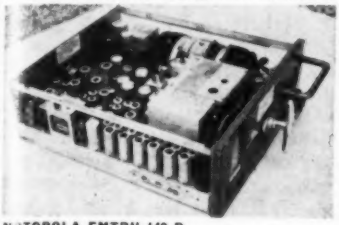
Catalog #17, 30-50MC-6V DC ..... Price $44.50
Catalog #18, 30-50MC-12V DC .... Price $52.50
15" Case for above, Catalog #19 ... Price $ 2.50



MOTOROLA FMTRU-140-D
MOTOROLA FMTR-140-D
This unit has a 60 watt transmitter using 829B in final. Vibrator P.S. for receiver anh Dynamotor for Transmitter. Shipping Wtg. 50 lbs.
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Catalog #21, 30-50 MC 6V ..... Price $54.50
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80D and 140D units have chassis cutouts for adding 2nd frequency oscillator deck to transmitter.

F M Equipment

All equipment is offered to licensed radio amateurs only. Quantities are limited to two items to a customer. Each unit unless otherwise noted is a complete receiver, transmitter and power supply, a tube or two may be missing. Cases, cables, microphones, control heads and crystals are not available. Equipment is offered "as-is." Any purchase may be returned to us, freight prepaid, for a full refund if you are not satisfied. All items subject to prior sale—Terms: Payment with order—Shipping: FOB Boston—Specify carrier. Prices and specifications subject to change without notice.

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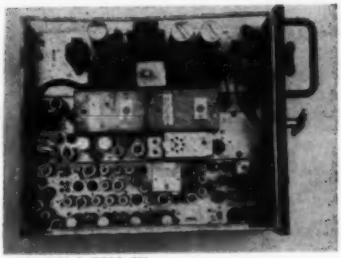

MOTOROLA T44A 6V
Transmitter has 2C39 final in cavity. Will tune to 432MC readily. Output is 15-18 watts. 2C39 tubes included, a few small tubes and crystals may be missing.
Catalog #10 ..... Price $40.00
15" Case for above, Catalog #19 ... Price $ 2.50

BOOKS

Wide-Band FM for the Amateur by Aagaand and Dubois. Covers specific conversion of Motorola gear to 2 meters. 47 pages Price $1.75 postpaid

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Belgium Rally

Sept. 22

Special licenses can be had for operation in Belgium from Sep. 14th to 30th for participation in the Red Cross Centenary Radio Rally on 2M and 80M phone. Write Rene Vanmuysen ON4VY, 81 Rue J. Baus, Wezembeek-Oppen, Bt., Belgium, giving names, addresses, calls of all ops, car license, dates in Belgium, photo copy of your ham license, power and freqs of your mobile rig covers. If you are going to be around on Sep. 15th you may want to try a fox hunt in Brussels. For details on this direction finding contest write V. Claeys ON4UM, 68 Rue Haute, Beersel, Brabant, Belgium. If you would like a Dutch license for the same period send the same info to N.A.S. Fitch G3FPK, 79 Murchison Rd., Leyton, London E 10, England.

YOU NEED THIS!

Hardware special—No junk—5 pounds of machine screws and nuts, all made recently to mil. specs. All brass, mostly nickel plated. Slotted head screws. 4-40, 6-32, 8-32, 10-32. About 20 varieties, separately bagged. **About 1500 pieces.** 5 pounds, $2.75 10 pounds, $5.00.

PRECISION 60 cycle FREQUENCY STANDARD Transistorized, crystal-controlled. Operates on 12 volts DC. Output is 16 volt peak-to-peak complementary square-wave into 15K ohm load. In aluminum can 1¾" diam. x 5" long, plugs into octal socket. Original cost $165. Like new. Only 12 available. $15.00 each.

JEFF-TRONICS
Send for our 20 page catalog
4791 Memphis Ave. Cleveland, Ohio 44109

HIGH-MFD CAPACITORS			
2500 MFD 100 WVDC			$2.25 delivered
3500 MFD 100 WVDC			2.75 delivered
1300 MFD 150 WVDC			2.10 delivered
2200 MFD 150 WVDC			2.45 delivered
150 MFD 400 WVDC			2.50 delivered
200 MFD 400 WVDC			3.10 delivered
175 MFD 450 WVDC			3.10 delivered
CONICAL STANDOFF INSULATORS			
height	base dia.	price	
1"	¾"	10 FOR	95c delivered
2"	1⅛"	6 FOR	1.65 delivered
3"	1½"	4 FOR	2.65 delivered
above with hardware			
CYLINDRICAL STANDOFF			
2"	1"	4 FOR	1.25 delivered

HIWAY COMPANY
SATISFACTION GUARANTEED
1147 Venice Blvd., Los Angeles 15, Calif.

Short Items, but Interesting

Second Op

Some of the newer DX'ers may not be familiar with W9IOP's "Second OP" slide chart. They should be. For one dollar "Electro-Voice, Buchanan, Michigan, will mail you this gadget which will save you a lot of time in looking things up in the Callbook.

The slide-chart has all of the countries listed by call letters prefix and gives you the location, zone, country, great circle bearing, time differential and postage rates as you dial. The chart also has the QSL Bureaus listed, which can be handy.

Electro-Voice has just brought the chart up-to-date on both countries and postage, so send for one f these Second Ops and keep it on the operating desk to help you in DX'ing and QSL'ing.

Club Subscriptions

At the next club meeting we would appreciate it if you would call our group subscription rate to the attention of the members. In groups of five or more simultaneous subscriptions (or renewals) the rate is $3.00 per year until our coming subscription rate increase (shortly). Please be sure to send five or more at once, include calls and QTH's and issue we should start the sub with.

HOW WILL IT ALL COME OUT?

Will Wayne get his head handed to him? Will Clif Evans get sued? Will the ARRL change their tune? Will our next issues be as big as we think they will be? Subscribe and see. Subscribe anyway.

Name ..... Call .....

Address .....

City ..... Zone ..... State .....

☐ $3.50 One Year ☐ $6.50 Two Years ☐ $9.00 Three Years

☐ $40 Life (yours or ours)

50c each enclosed for the following back issues .....

(All 1960 issue $1)
(Jan. '61 out of print) Class license .....

☐ $1.00 enclosed for one year membership in Institute of Amateur Radio.

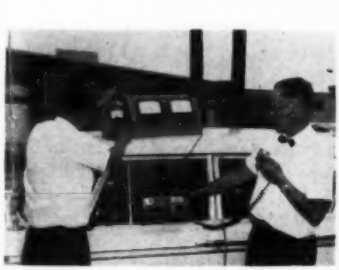
Send to: 73, Peterborough, N. H.

Mobile Clinic

One of the biggest problems with mobile operation is getting that antenna tuned up right. New-Tronics is doing something about the problem: mobile clinics wherein test equipment is brought out to check the power output of transmitters and the match of the antenna. This is a service to hams that would do well to be spread.

These clinics are being conducted by John Altmayer K8UQV, New-Tronics President and Fred Ohman W8FAT, Electronics Sales Manager.

John K8UQV, H. E. Ruble W8PTF of SREPCO and Fred W8FAT look over a well tuned car at SREPCO in Dayton where several hundred hams attended the clinic.



Fred W8FAT checks output of new Drake TR14 transceiver for Clem Wolford W8ENH using a Waters Dummy (no offense) Load Wattmeter.

COLUMBIA GEMS!

MOTOROLA 30-D TYPE FM BASE STATION

30-40 Mc. Transmitter-Receiver. 50 W. output. Housed in beautiful 5½ ft. metal cabinet with 3 meters and built-in speaker. Power input 110 VAC, 60 cyc. Desk console remote amplifier. This is a superb unit in excellent cond. Great buy! $149.50

NAVY MODEL RAX RECEIVER

Unit No. 1. 200 Kc.-1500 Kc. Like new. ONLY $24.95

AN/ARC-3 MAINTENANCE MANUAL. Late edn. $9.95

COMMAND TRANSMITTERS

2.1-3 Mc. New.	$6.95	4-5.3 Mc. New	$7.95
3-4 Mc. Excel.	7.95	5.3-7 Mc. (Less tubes)	2.95

TRANSISTOR TAPE RECORDERS

So low in price—so high in value! Importers' close-out! These units record, play back, and erase. Built-in speaker, single speed, volume control, etc. Comp. with mike, batteries and case. Reg. $29.95. Like new & excel. cond. $9.95
SAME AS ABOVE, but less case and mike. As is: $3.95

TRANSMITTING TUBE SPECIALS!
All new, unused — guaranteed!

4-65A	$ 9.95	811	$ 3.95
4-125A	19.95	811A	5.95
4-400A	24.95	813	12.50
807W/5933	2.95	832	4.95

COLLINS ART-13 RADIO TRANSMITTER

2-18 Mc. 100 W. output. **This is the famous one!** Excellent condition. A terrific buy at only $49.95
GOOD CONDITION $39.95

HEADSET & MIKE BARGAINS

HS-23 HEADSET: 4,000 ohms. New ..... $ 4.95
HS-33 HEADSET: 600 ohms. Brand new ..... $ 5.95
T-17D CARBON MICROPHONE: Brand new ..... $ 9.95
RS-38 CARBON MIKE: With coil cord and PL-68 Plug. Brand new and bargain buy ..... $ 9.95

COLUMBIA SPECIALS

R-388/URR COLLINS 51J-3 RADIO RECEIVER: Excel. Checked out. Guar. $595.00
HAMMARLUND SP-600 RADIO RECEIVER: Excel. Checked out. Guar. $449.50
H.P. MODEL 524A FREQUENCY COUNTER: Excel. Checked out. Guar. $895.00
TEKTRONIX 511-AD OSCILLISCOPE: Excel. cond. Checked out. Guar. $195.00
TEKTRONIX 511-AD OSCILLOSCOPE: Excel. cond. Checked out. Guar. $395.00
MEASUREMENTS CORP. MODEL 80 SIG. GENERATOR: Excel. Checked out. Guaranteed. A Columbia Special. Only $345.00
I-205D FM SIG. GENERATOR: 1.5-4.5 Mc. and 19-45 Mc. New cond. Checked out. Guaranteed. Reg. $150.00. Only $89.50
PP-823/ARC-32 GROUND AC POWER SUPPLY FOR ARC-27: 110 V. 60 cyc. Less case. Excel. cond. Checked out. Guar. ... $89.50
POLARAD MODEL TSA SPECTRUM ANALYZER: Less tuners. Excel. cond. Checked out. Guaranteed $495.00
VECTRON MODEL SA-20 SPECTRUM ANALYZER: With S-Band Tuner. Excel. cond. Checked out. Guar. Only $595.00
LR-1 GENERAL RADIO HETERODYNE FREQUENCY METER: 160 Kc. to 15 Mc. .003% on fundamental. Excel. Checked out. Guar. $295.00
TS-382D/U AUDIO OSCILLATOR: 20-200,000 cyc. Excel. Guar. $295.00
TS-403/U SIGNAL GENERATOR: This is military version of H.P. 616A. 1800-4000 Mc. Excel. Checked out. Guar. $695.00
PRS-3 LINE DETECTOR: This is the hot 1953 model. Excel. $39.95
SCR-625C MINE DETECTOR: World War II Model. New. FOB Los Angeles or New York City, N. Y. $39.95
RT-82/APX-6 TRANSCEIVER: 1220 Mc. Excel. cond. $24.95
SCR-522 2-METER TRANSCEIVER: Excel. cond. Only ... $19.95

COLUMBIA ELECTRONICS
4365 WEST PICO BLVD. LOS ANGELES 19, CALIF.

Before you become a Silent Key

Carole Hoover K9AMD

According to the old saying, there are just two things you can count on: death and taxes. Settling up with Uncle Sam may be a must every April 15, but a fellow usually isn't forced to ponder his date with the Grim Reaper—and many don't. Ever!

Admittedly, it may sound morbid to suggest thinking seriously about joining the Silent Key list, but it's time something was said. Too often, a ham magazine carries the sad story of an ill-advised widow who sold her OM's deluxe station for a song. Every year, thousands of dollars are lost to needy wives and children who simply don't know what their relatives have invested in amateur radio equipment. And they're really not to blame.

There's probably not a ham on the air who hasn't pulled a sneaky trick to get a transmitter, receiver, or other accessory into the house without an uproar. Have you ever heard of a guy telling the little woman that his new rig cost about half the actual price? Or of a purchase made half by check and half by cash to keep the XYL from raising Cain about it? Sure you have. And in many ham shacks, equipment catalogs are carefully concealed to keep the folks or the lady of the house from throwing cold water on a dream station or antenna system.

The only way to help your wife or parents avoid a real skinning should you pound at the pearly gates before expected is to put some prices and values in black and white. A complete inventory of equipment kept up to date and filed among personal papers is a simple solution. One Midwest ham prepares labels giving model number, purchase cost, and suggested selling price and sticks it to each piece of equipment. This plan proves helpful for swapping purposes at any time.

Another suggestion is to gather the family and have a down-to-brass-tacks discussion of how to get the most out of equipment. Many electronic firms mail fliers listing surplus gear and current selling prices. And if a wife knows the right firm to contact, she can get the facts and figures to use as a guide. An only-ham-in-town should make certain his wife has the name and address of a trusted friend, also licensed, who could assist her in the disposal of equipment at fair prices.

Life begins at 40, somebody said, and you may be able to cut the mustard at 100; but just in case you should make a wrong turn during an orbital flight or decide to pull a Rip Van Winkle, why not assure your family of the returns they should have from your investments.

. . . K9AMD

General Coverage with the Collins S Line Receivers

Ray Moore K1DBR

The Collins 75S-1 and 75S-3 hamband receivers will tune a large segment of the high-frequency bands outside the amateur bands with no alterations of any kind. They will tune 15.033 mc to 15.433 mc which includes almost all the 19 meter broadcast band and 11.533 mc to 12.133 mc, with a 100 kc gap, which is most of the 25 meter broadcast band, as well as the 8.923 mc to 9.323 mc band. No extra crystals are required.

This is possible because the preselector (rf and mixer) tuning is not ganged to the vfo in the "S" line receivers. It works like this, taking band 3C as an example. This band covers 14.8 to 15 mc using a 8.9775 mc crystal in the first oscillator. The first *if* has a bandpass of 2.955 mc to 3.155 mc. Using the second harmonic of the crystal we get $17.955 - 2.955 = 15.000$ mc and $17.955 - 3.155 = 14.800$ mc. Performing the same arithmetic using the fundamental of the crystal except that we must use the sum of the frequencies (explained later) we get $8.9775 + 2.955 = 11.9325$ mc and $8.9775 + 3.155 = 12.1325$ mc. A look at the preselector tuning curves in the instruction manual tells us that the preselector will tune 11.933 mc to

SUMMER SPECIALS FROM SPACE

BC-221 Freq. Mtr 125kc to 20mc/s $70.00
TS-174/U Freq. Mtr 20mc to 250mc/s $150.00
TS-323/UR Freq. Mtr 20mc to 450mc/s $195.00
TS-175A/U Freq. Mtr 85mc to 1000mc/s $135.00
AN/URM-25D Sig. Gen. 10kc to 50mc $395.00
TS-588A/U Sig. Gen. 5kc to 50mc/s $390.00
TS-418/U Sig. Gen. 400mc to 1kmc $325.00
TS-419/U Sig. Gen. 900mc to 2100mc/s $475.00
TS-155C/U Sig. Gen. 2700mc to 3400mc/s $135.00
Ferris Mod 18c Microvolter 5 to 175mc/s $95.00
Gen. Radio 1208B 65mc to 500mc/s $140.00
FXR-W410A Wavemeter $100.00

Ballentine 300 VTVM $99.00
Hewlett Packard 400C VTVM $115.00
Hewlett Packard 430B Power Mtr $120.00
Hewlett Packard 526B Plug-in $110.00
Hewlett Packard 525A Plug-in $130.00
Hewlett Packard 526C Plug-in $125.00
Hewlett Packard 100A $100.00
TS-382D/U Audio Gen. 20cps to 200kc $295.00
TS-268D/U Extal Rectifier Test Set $17.50
Simpson 260 VOM $25.00
TS-375A/U VTVM $65.00
Simpson 303 VTVM $55.00
Tektronix 105 Sq. Wave Gen. $190.00
Tektronix "CA" Plug-in Head $140.00
Tektronix "K" Plug-in Head $75.00
Dumont 304AR Scopes $195.00
Dumont 256D Scopes $99.00
Dumont 324 Scopes $245.00
EE-8 Field Phone—Like New Complete 12.00 ea. 2/$20.00
Nylon Box Kite for Field Day etc. $4.95
T-179/ART-26 HAM TV Transm. w/All Tubes $59.50
Sperti Vacuum Switch for Art-13 Etc $1.00
General Radio 200B Variac New $7.50
100 ft. Rg 11A/U Coax w/PL-259 Ea. End New $5.95
3ph Transitron Stack Rectifiers 50v PIV per arm 47amps New $19.95
255A Polar Relays $4.50
Sockets for Above Relay $2.50

PL-259, SO239, M-359-UG-100A/U New Any 3 ..... $1.00
T-18-ARC-5 Transmitter 2.1 to 3mc New $9.95

RECEIVERS

SP-600 JX—540kc-54mc/s $450.00
R-388 (51J3) 500-30.5mc/s $575.00
R-390 Digital Job 500-32mc/s $990.00
URR-13 225 to 400mc/s $420.00
AR-8506B RCA Marine Rcvr. $240.00
AR-88 500kc to 32mc/s $170.00
CR-10 RCA Fixed Freq. $75.00
Wilcox F-3 Fixed Freq. $65.00

Boonton 212A Glide Scope Tester L/N $750.00

NEW SURPLUS TUBES GUARANTEED

2C39A	$7.50	250TH	$18.50	GL6442	$20.00
3CX100A5	$10.00	4X250F	$25.00	5894	$17.50
6161	$35.00	807	$1.00	416B	$12.95
4-65A	$7.50	6360	$3.50	7212	$4.95
8005	$14.00	7580	$34.80	3-400Z	$26.00
807W/5933	$2.00	6AN5	$1.25	3-1000Z	$78.00
5881	$1.50	723A/B	$3.00	4X150A	$9.95
4-125A	$20.00	2E22	$2.90	4X250B	$20.00
2K25	$5.00	4X150D	$9.50	4X150G	$25.00

SK-640 Eimac Sockets for 4X150A, 4X250 B, etc $4.25 each 2 for $8.00

We buy & sell large quantities of Military and Commercial Test Equipment. AN/GRC, PRC, TRC and test equipment TS and AN/UPM or URM. What have you for sale or trade?

—MONEY BACK GUARANTEE ON ANYTHING WE SELL—
ALL SHIPMENTS FOB BRONX, N. Y.

SPACE ELECTRONICS CO.
218 West Tremont Ave., Bronx 53, N. Y.
TRemont 8-5222

12.133 mc at about 4½ on the scale with the bandswitch on the "C" range.

The reason we had to take the sum of the frequencies in the example above is that the different frequencies give a range of 5.833 mc to 6.023 mc which is outside the preselector tuning range for band C. When using the sum frequencies the tuning is backwards but the 1 kc per division tuning rate is maintained so it isn't at all difficult to interpolate any dial reading. On band D it is possible to use both the sum and difference frequencies of the fundamental.

The table lists the frequencies which can be tuned using this method.

. . . K1DBR

Band	Preselector Setting	Main Tuning Dial 0	50	100	150	200
3D	4½	15.433	15,383	15.333	15.283	15.233
2D	4½	15.333	15.283	15.233	15.183	15.133
1D	4½	15.233	15.183	15.133	15.083	15.033
3D	1	9.123	9.173	9.223	9.273	9.323
2D	1	9.023	9.073	9.123	9.173	9.223
1D	1	8.923	8.973	9.023	9.073	9.123
3C	4½	12.133	12.083	12.033	11.983	11.933
2C	4½	11.833	11.783	11.733	11.683	11.633
1C	4½	11.733	11.683	11.633	11.583	11.533
1E	1¾	12.673	12.723	12.773	12.823	12.873

A FEW LUCKY BUYS
(I fell in)
SAVINGS PASSED ON!

Mechanical Filter	COLLINS type F-250-85 250 KC, 8½ KC band width for mobile AM.	$12.00 ea.
Crystal Oven	BLILEY #TCO-1,6.3v .85A 75 C, takes HC6 U crystal. Fits into octal socket.	$2.50 ea.
⅝" Punch	GREENLEE, BRAND NEW	$1.25 ea.
RG9B/U 51 Ohm	Silver plated RG8/U 30' with 2 UG-218/U BRAND NEW, surplus.	$2.25
Dual 75mmf 9000V	EFJ, Split stator. ¼" gap. 2 bearing, 2 ¼" shafts. NEW. → 6146A	$10.00 $3.00 ←

COMMAND TRANSMITTERS
back to 1947 prices!

T-18/ARC-5	2.1 to 3 MC convert to 160 meter. BRAND NEW	$6.50
T20/ARC-5	4 to 5.3 MC, convert to 80 or 6 meter. Ex. used $5.00.	Brand New $5.75
T21/ARC-5 or BC-458	5.3 to 7 MC, convert to 40 meter, or use with CENTRAL ELECTRONIC'S SSB-VFO Kit. Very excellent used.	$6.50

Save your loot, I'll have a wagon load of GOODIES at Warren, Ohio Aug. 25; Cedar Rapids, Iowa Sep't 1; Findlay, Ohio Sep't 8; Peoria, Ill. Sep't 15; Cincy, Ohio Sep't 22.
All orders, except in emergency or I'm at a hamfest, shipped same day received. For free "GOODIE" sheet, send self addressed stamped envelope—PLEASE, PLEASE—include sufficient for postage & insurance. Any excess returned with order.

B C Electronics
Telephone CAlumet 5-2235
2333 S. Michigan Ave Chicago 16, Illinois
AMATEUR, AIRCRAFT AND MARINE RADIO EQUIPMENT
PARTS AND ACCESSORIES

WANTED TO BUY
TOP PRICES PAID
RT-77, RT-66, 67,-68/GRC
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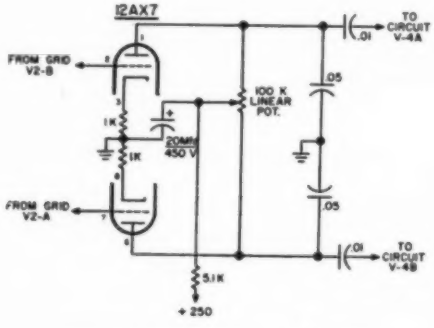
ARC-27, 34, 55, 65, etc.
ARN21 & higher; APN-22, APN-70
AN/VRR-13, -21, -28, etc.
TS-, & AN/UPM, -URM, -USM
as well as commercial test equipment.
Advise condition & price — We pay freight
Amber Industrial Corp.
75 Varick Street, N. Y. 13, N. Y. — CAnal 6-7455

Improving the W2JAV RTTY Converter

After building the W2JAV radioteletype converter I could not see too much advantage in using the T. W. Groger, W7HJC, brain child in the circuits of tubes V3 and V4.

Finally the two 47K-ohm resistors in the plate circuits of V3A and V3B were changed over to a single 100K-ohm linear pot. After once adjusting this pot along with R-1, the 50K ohm balance control, the brain child of W7HJC started doing its proper job. Now I can copy RTTY signals that I thought were impossible.

. . . K4GRY



IMPROVING THE W2JAV RADIOTELETYPE CONVERTER

SEE PAGE 43 OF APRIL, 1958 '73'

(W2NSD from page 6)

raise any strenuous objections to our filling this obvious void.

Perhaps in a few months we will be able to get our Area Coordinators together and evolve a more formal organization. In the interim I am going to act as Interim Secretary and start the ball rolling. By the time you have read this a letter will have been sent to all Institute members explaining this project and asking for volunteers who are willing to invest some of their hamming time and perhaps even some postage and phone money in acting as Area Coordinators or Division Directrs. I've asked them to send in a short resumé of their ham and personal background. I'll send out a copy of these resumés to all of the Institute members in each area so they can vote for the men they think will do the best job for them as Coordinator and Division Directors. It seems to me that we will be a lot better off to have all of the members voting for their officers rather than having a set of Directors electing their own choice for officers, which could end us up with officers seeing to it that the Directors are voted in which will perpetuate them in office . . . a round robin which we've already seen and don't want to duplicate.

Membership in the Institute is $1 per year. How about *you*, will *you* help?

Boo Boo

There was much to-do last month when we managed to print the issue before a major error was discovered in the Linear Systems ad. The prices on their two inverters are remarkable enough without their being transposed. The 150 watt model (12 volts dc to 120 volts at 60 cycles) is small and light enough to mount just about anywhere in the car. I've always mounted an inverter in my cars so that when I want to run a small rig, tape recorder, public address system, etc., all I have to do is plug it in. 150 watts will handle most gear easily.

Europe

The Institute trip to Europe is in fine shape. We've about 75 coming along. A list of the members of the trip is available for the price of a self addressed stamped envelope, complete with a short biography of most of the tourers.

We leave Idlewild October 6th in the evening, fly to London for four days . . . then Paris, Geneva, Rome, Berlin and back to New York on the 28th. The round trip fare, for anyone interested in joining us, is $550. This includes all transportation, hotels and breakfasts.

Hello CQ

The July issue of CQ finally dedraggled itself in here the other day. Come on CQ, you can do better than that! Since a great many of 73's readers no longer bother with CQ I'll give you a short rundown on this issue.

After piecing together the torn shreds of cover I found that they were busy celebrating

MADT HI FREQ TRANSISTORS

All guaranteed, factory marked. exint for converters, CB transmitters, 6 meters, etc. Factory closeout bargain. 5/$1.00

48 VOLT DC REGULATED

SOLA 48 volt DC 4.5 amp regulated plus 6.3 at 3 amps 115 volt 60 cycle input. Like new. $17.50

AN/PDR-27 GEIGER COUNTER

One of the Navy's finest. 4 ranges .5-5-50-500 MR/HR Detects Beta & Gamma. Detachable probe on coil cord. Complete ready to use with headphones (not shown) and shoulder strap. With Fresh batteries. Just in time for Summer prospecting. $35.00

LATCHING RELAY
24 Volt DC coil, latch & unlatch. 4PDT 10 amp contacts. $1.50

POWER TRANSFORMER
115 volt 60 cycle
2,540 volt CT 400 ma
Stock #T-50 $12.50

PYRANOL CAPACITORS
8 MFD 1,500 VOLT $1.75

SWINGING CHOKE
.40/.10 amp
4/12 Henry
Stock #CK-1 $4.00

866 TRANSFORMER
2.6 volt 10 AMP $3.00

JOHN MESHNA, Jr.
Surplus Electronic Material

19 ALLERTON ST. LY 5-2275 LYNN, MASS.

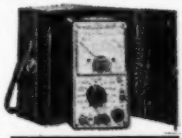
Catalog #63 just off the press. 10c handling would be appreciated.
All material FOB Lynn, Mass.

the RSGB's 50th anniversary. If your copy arrived without a shredded cover you didn't miss anything. I sure wish they would spend the fraction of a cent necessary to mail it in a wrapper. Inside I found at least six articles that seemed awfully familiar . . . aha! . . . I'm sure that at least five of 'em have been here first and been rejected. The sixth was a reprint from a year old copy of the now defunct VHF Amateur, though not labeled as such. The editorial opposed the ARRL proposal for Techs to have the entire two meter band.

This did it to me. In June they backed up the ARRL's disasterous proposal to segregate our phone bands and this month they come out in opposition to Techs on all of two meters, a not unreasonable proposal. There is nothing like being out of step *all* the time.

The present system of having two separate two meter bands is a hardship on all operators. It unnecessarily discriminates against the Technician during contests when a good deal of the activity is going on down at the forbidden low end. The level of QRM is low enough so there is no advantage to the enforced spreading out of stations, it just makes it that much more difficult to tune the band. Let's open 144-148 to the Techs.

. . . Wayne



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Measures:
DB - Volts - Mils
(AC - DC) ohms
$12.95 complete

Also have pocket size multi-meter $6.95

Send self addressed envelope for PANEL METER listings.

ARROW SALES 2534 S. Michigan Ave. Chicago, Ill.

ALL BAND TRAP ANTENNA !

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73 PRODUCTS

73 Parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 ..... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 ..... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W6DUT-2 ..... $20.00

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

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Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

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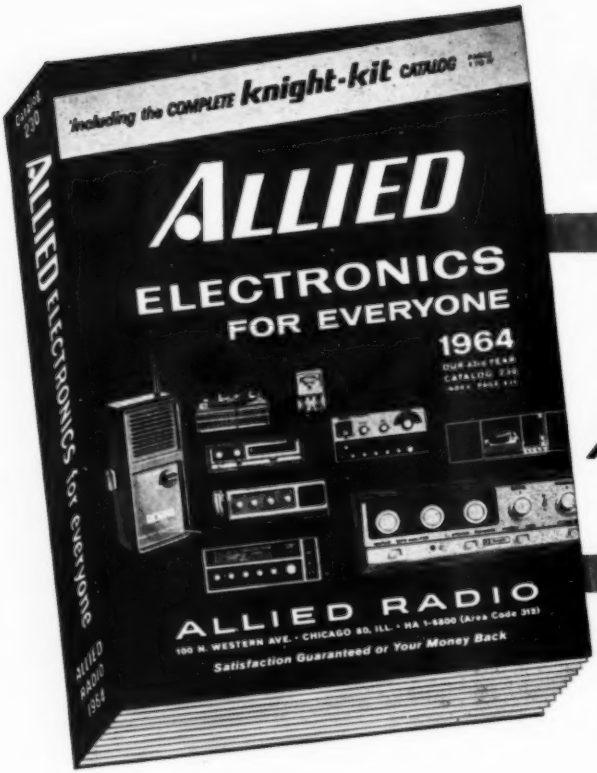

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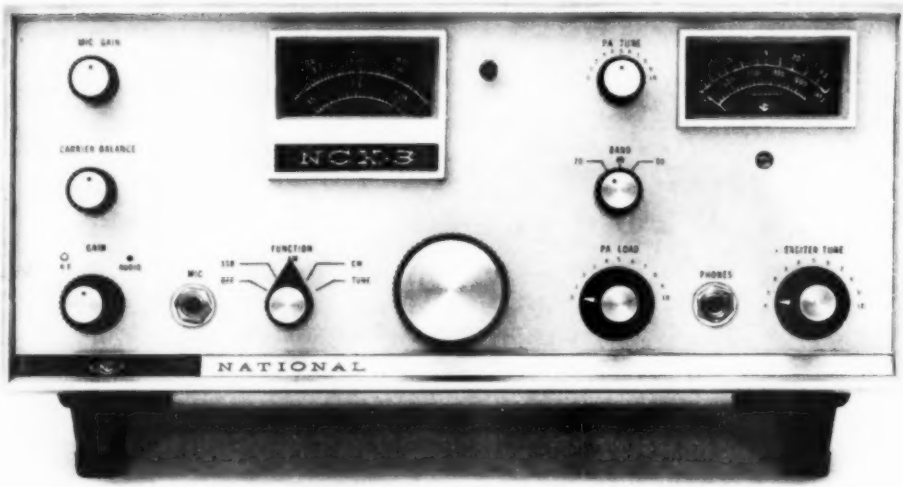

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